

Aviation Week

and *Space Technology*

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A McGraw-Hill Publication

July 18, 1960

Pilot Report
On Convair
Turboprop

First American Airlines Boeing 720

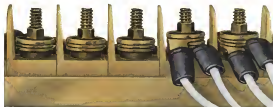


New Materials Aid Missile Heat Shielding



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KAYLOCK® NUT VITAL LINK IN NEW TERMINAL BLOCK



Using a new Kaylock® nutless washer nut to save weight, space and assembly time and to eliminate loose washer problems, Lockheed Aircraft Corporation has achieved the first major structural block improvement in 20 years. The revolutionary LR 7000 Lockheed Dressnut Block, initially used on the Electra, is much smaller and lighter than the old AN nut it replaces.

The Kaylock MW 19873 self-locking nut with integral, free-spacing metal washer permits terminals to be spaced closer together, requires less wrench clearance and speeds up assembly by eliminating extra steps not inherently required to attach washer in both. It's safer, too! No chance of dropping washers into places where they might do damage. If you have a special locknut problem you would like to have solved, a Kaylock sales engineer is as near as your phone. Call him today.



Kaylock.

(pat. to Daylight Industrial)



KAYNAR MFG. CO., INC., KAYLOCK DIVISION
Box 2001, Thousand Arroyo, Los Angeles 54, Calif. Branch offices, warehouses
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Wing section of Bondolite is this lightweight, 20% lighter than riveted or welded sections.



Bondolite's strong edge of Bondolite is 20% lighter than riveted or welded sections.



Bondolite's new made of Bondolite is 20% lighter than riveted steel or metal.



Mounting board for customer after center replacement is fabricated of Bondolite. Weight savings? 20%.



Adhesive roller reflector of Bondolite is lighter by 20% than conventional reflectors.

HERE'S A "WEIGHT REDUCER" THAT ADDS POUNDS TO YOUR PAY LOAD!

It's Bondolite by Goodyear Aircraft—just one of the highest strength-weight ratios of any polymer material. Works and plane makers use this light but strong substance a great deal for decks, bulkheads, mounting boards, engine casings—wherever they want great strength with no attention to pin load—or even pin load for the same weight.

Strong? One type of Bondolite actually withstands pressures of 66,000 psi without bonding! Yet you can work Bondolite with ordinary shop tools.

Goodyear engineers Bondolite to your exact specifications—in many sizes and shapes: from 1/2" to 5" thick (even thicker on special order), to the most exact tolerances. There's a variety of uses for a variety of applications—metal fasteners, plastic and glass bolts, stainless steel. And there's a wide variety of surface treatments: paper, fiberglass, aluminum, stainless steel, titanium, glass and fancy textures. Bondolite can also be patterned, machined for extra rigidity and wear resistance or for decorative values.

Save weight—retain strength—specify Bondolite by Goodyear for scores of airplane and missile parts—floor panels, substructures, landing edges, component doors. For full details write us company letterhead to Goodyear Aircraft Corporation, Aero-Mechanical Division, Dept. 916AS, Akron 15, Ohio.

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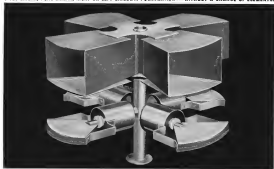
Lots of good things come from

GOODYEAR AIRCRAFT

Plants in Akron, Ohio, and Lockfield Park, Arizona

NEW MULTI-POLARIZED ANTENNA

GIVES LINEAR, DUAL LINEAR, RIGHT OR LEFT CIRCULAR POLARIZATION WITHOUT A CHANGE OF ELEMENTS



Automatic flexibility at an exhibited cost. Now, with one antenna, you can select the polarization mode best suited for a particular remote or space vehicle. Selection may be done remotely, if desired. Direct application can be found in communications, tracking, telemetry, or command control fields. This Chance-Vought Electronics antenna development eliminates the need for changing elements to conform to polarization changes from a remote or satellite source. Yet its cost is no greater than that of a comparable helical design.

Low-drag, lightweight design. With the Multi-Polarized System, element height reduction is four to one when compared to an equivalent helical array. Weight and drag savings in the Vought antennas allow the use of a lightweight pedestal and offer broad location freedom. The Pacific Missile Range's first tracking vessel, USS Skatesee Victory, is being equipped with Vought's Multi-Polarized Antenna System.

FOR FULL PERFORMANCE AND DELIVERY DETAILS

...or for an interesting summary of ground and airborne antenna applications from the developer-producers of 185 different systems, write:

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ANTENNAS • AUTOMATIC CONTROLS • NAVIGATIONAL ELECTRONICS • GROUND SUPPORT ELECTRONICS



VERSATILE METAL FABRICATION

...near Southwestern
electronics and airframe
manufacturers

In the center of the Southwestern complex of space-age activity is Continental-Emco's huge steel fabricating facility. This versatile plant covers 77 acres... 396,505 sq. ft. under roof. It's complete with machining, boring, milling, and turning equipment, spacious fabricating bays and creative staffs for engineering and Research & Development. Quality-control measures meet MIL-Q-9858 standards.

Versatility to handle any metalworking job is evidenced by this plant's production of propellant trucks, rocket launchers, crane trucks, marine guns, cargo winches, airframe parts, towers, and a complete line of oil field equipment. Illustrated is a typical 100' triangular tower built by Continental-Emco.

Get Continental-Emco's quotations on your next equipment contract.



CONTINENTAL-EMSCO COMPANY

ENR

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WHAT WAS SINGER DOING AT PARADISE? Major underwater endurance projects are underway at the President Facility of the U. S. Naval Ordnance Test Station, China Lake, California. Here Singer worked closely with scientific and engineering teams in vehicle water entry studies. Representatives of the Singer Military Products Division are busy working with civilian and military teams engaged in equally critical defense work at bases all over the country. A division of The Singer Manufacturing Company, RMFD is composed of Singer-Bridgport, Diehl Manufacturing Company, and HRR-Singer.

A top performance brochure describing RMFD engineering and production facilities is yours for the asking.

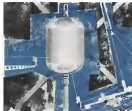


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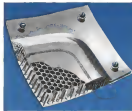
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ROCKET MOTOR CASE Brunswick's exclusive 10 mil thickened "B" Phenolic fiber glass filament winding gives SD ratio to 3,000,000, provides up to 7,500,000 psi modulus. By laying down filaments under tension, RSP excels in making cylindrical shapes, unusual contours, large range of sizes. Post-curing gives evenly controlled uniformity.



RADOMES Brunswick's non-metallic materials have best tolerance of radomes and cone scans to 3000-3000° F. for limited exposures. RSP filament winding gives lightweight strength-to-weight ratios with significant weight savings over metal structures. With unannealed electrical insulators, Brunswick builds in optimum tolerance for dielectric resistance and compound seal porosity.



HONEYCOMB ASSEMBLIES were developed by Brunswick and support one million times their own weight. Brunswick research has created honeycomb assemblies of paper, fiber glass, aluminum and various combinations of these materials. Using the most advanced adhesive systems, these assemblies can be formed in compound environments with extremely close tolerances.



INTEGRATED ANTENNAS Brunswick totally integrates all communications, telemetry and navigation antennas and radomes within primary structure. No sealing or re-venting transmitters. All-plastic aircraft and missile antennas give high weight-to-strength ratios, while providing aerodynamically clean lines. Cox Brunswick Corporation helps you in any way? Write or call today!



BRUNSWICK

DEFENSE PRODUCTS DIVISION • 1700 MESSLER STREET • MURKISON, MICHIGAN



Made to last — Sound-suppressor and thrust-reverser units for Convair 580 developed by General Electric will resist critical parts made of HAPDO.

Good 'W' nickel-chromium alloy. The delay-cooler type suppressor is seen at rear of jet. Thrust-reverser vanes are just forward of the suppressor.

How Convair 880's sound-suppressor and thrust-reverser units resist heat, oxidation and corrosion

Three of the best reasons in the world led General Electric designers to choose a Huntington Alloy Products Division metal for vital parts in Convair 880's sound-suppressor and thrust-reverser units:

1. **Heat resistance** — HAPDO nickel-chromium alloys have 1000-hour rupture strengths that go as high as 40,000 psi at dull red heat.
2. **Corrosion resistance** — HAPDO nickel-chromium alloys show excellent resistance to oxidation and corrosion by jet-hot exhaust gases.
3. **Fabricability** — HAPDO nickel-chromium alloys are readily fabric-

ated. They can be cut, bent by many processes. What's more, welding can be done without reducing the metal's strength, without sapping its resistance to corrosion.

HAPDO materials — among them such widely used alloys as Inconel®, Inconel "X"®, Inconel "W"® and Invecol® — give a designer plenty of latitude. They meet exacting specifications. They're readily fabricated and welded by commonly used methods.

But perhaps even more important — almost anything you'd want to know about these versatile nickel-chromium alloys has been checked, reported, recorded and analyzed. As a result, our files are jam-packed with

useful information on many metal problems.

What's your design need? Are high temperatures a problem? Corrosion? Do you want more strength, less weight? One of Huntington Alloy Products' heat-resisting, corrosion-resisting nickel-chromium alloys may be just the material you've been looking for.

Your problem may already have been solved. So don't keep working on it alone. Write and get our advice and help. No obligation involved, of course.

How to be told

HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
Huntington 17, West Virginia



ALLOY PRODUCTS

TAPCO ELECTRICAL POWER COMPONENTS

TAPCO Group primary and auxiliary electrical power systems for space, missile, aircraft and ground power applications are tried and proven. Systems performed under environmental conditions including nuclear radiation, high temperatures, liquid metal types, zero-G and vacuum.

Below are typical TAPCO components now

available for integration into systems for earth applications. Other available TAPCO electrical power components include tachometer generators, speed sensors, high temperature electrogenerators and alternators, motor motor and drive controls, static inverters, voltage regulators and electronic power conversion devices.

ALTERNATORS

Among the special purpose rotating machines designed by TAPCO is a series of high temperature alternators. These range in capacity from a few watts to 15 kw at temperatures up to 1000 F.

Approximate data: TYPICAL ALTERNATOR—Power rating: 1 kw (1000 wpm); 10 kw (1000 wpm); 15 kw (1000 wpm). Operating Speed: 40,000 rpm. Output: 1000 wpm (1000 wpm). Voltage Regulation: 100%. Efficiency: 80%. Weight: 1 lb. at 1000 wpm; 15 lb. at 1500 wpm. Special Conditions: Service in vacuum space.



High Temperature Permanent Magnet Alternator



VOLTAGE REGULATION AND SPEED CONTROLS

Associated with the TAPCO alternator and drive systems are special speed and voltage controls for automatic accuracy, frequency and voltage regulation. The unit shown is adaptable to many drive systems.

Approximate data: TYPICAL SPEED REGULATOR—Power rating: 1 kw (1000 wpm); 10 kw (1000 wpm); 15 kw (1000 wpm). Operating Speed: 40,000 rpm. Output: 1000 wpm (1000 wpm). Voltage Regulation: 100%. Efficiency: 80%. Weight: 1 lb. at 1000 wpm; 15 lb. at 1500 wpm. Special Conditions: Service in vacuum space.

LIQUID METAL PUMPS

A rotating permanent magnet driven by an external source induces pumping force in the liquid metal within a hermetically sealed system. This concept provides operation without friction producing rotating seal and provides exceptional reliability and life.

Approximate data: TYPICAL ELECTROMAGNETIC PUMP—Power rating: 1 kw (1000 wpm); 10 kw (1000 wpm); 15 kw (1000 wpm). Operating Speed: 40,000 rpm. Output: 1000 wpm (1000 wpm). Voltage Regulation: 100%. Efficiency: 80%. Weight: 1 lb. at 1000 wpm; 15 lb. at 1500 wpm. Special Conditions: Service in vacuum space.



Electric Magnetic Induction Pump

Tapco Group Patent Registration
American Patent No. 1,000,000. In U.S. Patent Office pending. All TAPCO electrical power components are qualified engineers and scientists. Write: Personnel Director.



TAPCO GROUP
Thompson Ramo Wooldridge Inc.

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DESIGNERS AND MANUFACTURERS FOR THE AIRCRAFT, MISSILE AND SPACE, ORDNANCE, ELECTRONIC AND NUCLEAR INDUSTRIES

How recent thread advances contribute to the development of higher fastener fatigue strength

Fatigue and stress

It is a change in effective diameter that creates a stress rise, and with the threads, which consist of new upon row of notches, we have a really stronger stress rise. No wonder, then, that 85% of bolt fatigue failures occur in the threads.

It would also be well to keep in mind that fatigue is a surface phenomenon and that we can increase the fatigue life of a bolt by reducing the stress concentration by peening together of stresses on any surface.

Fully formed threads

Threads, of course, can be made by different methods—cutting, grinding, rolling—each with a different fatigue life. In the microphotograph shown here we note, in the slightly head view, that the fibers of the material have been cut due to the

FULLY FORMED CUT IN SKEWED

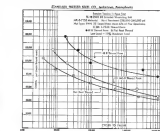


threading method. These cut fibers produce planes of weakness—create stress runs on the surface. The left case shows how the material has been made to follow the thread contour by rolling. The surface fibers of the material have been forced to follow the contour of the thread. This produces a much stronger, smoother thread. Fully formed threads, which are standard on all SPS bolts, thus add fatigue resistance to the most serious weakness of a fastener.

Stress relief after heat treatment

Fatigue life can be increased by inducing compressive stresses on a surface so that when a tensile load is applied, these compressive stresses are not reduced to zero, thus changing the tensile stresses. The surface of the metal, due to heat treatment, has the stress, but only the difference between that due to the applied load and the induced stress. This is precisely what we desire—a negative stress—by cold working the threads after heat treatment.

Two lots of bolts were tested to determine how substantial would be the resultant fatigue life gain. The only difference in lots was that in one the threads were rolled prior to heat treatment and in the other sub-treated to it. The endurance limit on the bolts with the cold-rolled threads was four times as great—80,000 as compared with 20,000 psi. Then bolts



subjected to dynamic loading should have threads rolled after heat treatment to obtain maximum fatigue resistance.

H-N Thread

A fatigue crack usually starts on the surface at the threaded end, with its sharp corners. Anything that could be done to make the thread root more resistant to fatigue would naturally increase the fatigue life of the fastener. The H-N thread root form does precisely that, because it is a smoothly beveled, radius-like, as best as contemplated surface—all of which contributes to the effective distribution of stresses.



Shown here are photomicrographs of flat root and H-N root forms made at the SPS Laboratories for Advanced Fastener Research. Each black line represents a plane of equal stress. . . the plain black lines, the stress follows potential. The prototype of the lines indicate stress distribution. With a flat root thread, stresses converge into hot spots at the sharp corners. The H-N thread reduces stress in these spots to a minimum and distributes the remaining stress evenly.



After the test is done, fatigue testing machine is kept in the machine.

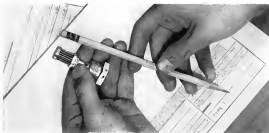
Implications: High-strength fasteners that are generally available do not just happen. Rather they are the result of painstaking and inventive design and development, processes involving techniques and machinery, and, of course, uncompromising testing.

Is that about the bolts you buy—bolts so critical to the success of aerospace projects? Will they really be the best? Evaluate your source of supply very, very carefully. Standard Process Steel Co., AIRCRAFT/MISSILE DIVISION, SPS, AERIAL/MISSILE DIV., FENNELLSVILLE, SANTA ANA, CALIFORNIA.

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Miniaturized cavity-type filter packs 4.2 square inches of filtering area into 1"x1/2" element

Paralox develops Hvac-air seal element to protect hydraulic costs of aircraft on Army's Hawk Missile mobile launcher.

How small can you make an element that must filter a 2 gpm hydraulic oil at 2500 psi to 100 temperatures within a 3/4" cage? Paralox's new miniature cavity-type hydraulic filter is the best answer to date. Here's why.

A 2 square inches of core thread stainless steel wire mesh are packed into that miniature filter. The element, which weighs 0.25 ounces, filters two gallons per minute of hydraulic oil, at temperatures ranging from -40° to +257° F. The element will withstand 2500 psi differential pressure without collapse.

The element is made up of a total of 1000s of stainless steel wires, woven into wire mesh and encased in a metal filtration unit. This element will remove 95% of all particles whose two smaller dimensions are larger than 10 microns, and 100% of all particles measuring 10 microns or more.

The picture at the top of the page shows a complete filter assembly, ready for installation in the hydraulic control system. The overall length at the end is 1/2", accurate to within .001". Total weight is slightly over 1 ounce. Designed as a cavity-type unit, the filter is installed simply by screwing it into the hydraulic system in the filter element housing of flow. The element can be removed, cleaned and replaced without special tools.

The picture at right shows the mobile launching station for the Hawk Missile. The compactness and mobility of the



launcher, and the probability that it would be subjected to severe jolting, made it necessary to specify a small filter to protect, and one that could be integrated with the rest of the system for maximum simplicity and durability.

The Paralox engineers who developed this new miniature cavity-type filter are available now to design a filter to meet your specifications. Simply contact Paralox Products, Inc., Department 3006, Edison, New Jersey.

Filters for Every Known Fluid

PARALOX

PRODUCTS, INC.

EDISON, NEW JERSEY AND CHICAGO, ILLINOIS BRANCHES

Notes of materials for the carpentry industry . . . selected from the 37,000 products of the 144 Companies

Notes of materials for the carpentry industry . . . selected from the 37,000 products of the 144 Companies

A flame would have a tough time surviving if it had to depend on 100's of new personnel on an island community. Designed as a "CoCoLa" island, the newest member of a range of island community state fire offices are really distinguishing (or perhaps not) by their extraordinary features. Contrasting special flame resistant additives in an immediate flame shock-proof jacket, the CoCoLa's island offices high-dose of flame resistance without the usual limitations. They are easy handling with little weight. In actual use, the flame retardants really act on two elements after the initial fire, diffusing

[illegible]

Good reliable connections are useful in any context these days, but in electrical industry they're imperative. If you're a technician it's difficult to maintain reliability, with today's high speed lubrication techniques. Our ELECTRICAL PRODUCTS Division has already come up with a means of doing just that. It's the new "Screw-It" Brass type UK connector. Although it's the functional equal of twist and solder joining methods for commercial use, it's a way out ahead in speed and convenience.

The whole subject area is then covered in a series of 10 chapters. They are made up of a straightforward, step-by-step manual, filled with sound advice, and one useful finger-to-thumb illustration. The manual, both as a top class technical reference and as a guide to the state of the art, is well illustrated and the layout is clear. The book is supported by the body of the text, using a spiral binding. The design of the book improves the ease of use and the quality of the presentation, making the book a pleasure to use. The book is a good one for the student, and a valuable addition to the library of the student. The book is a good one for the student, and a valuable addition to the library of the student.

"Skivvies" UK customers can handle any two or three wet combinations of 115 to 120 AWG and/or 120 to 130 AWG skivvies with. They can be used virtually anywhere a splice is made and on nearly every type of wire used in the communications industry. This would include wires associated with gas-insulated pipelines, paper, enamel, rubber, Teflon, or other materials. Your local Electron Products representative will be happy to show you how "Skivvies" customers can literally put your operations on a purchase-free basis.

Are the high frequency requirements of telemetry and radar signal decoding devices to be met completely by your current equipment? Our Minicore DDC-6000's new multi-IM-100 receiver independently permits you to track big in terms of bandwidth, but not cost. Name another receiver by any means, our DDC-6000 will show you the way.

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IM Company, Mine Industry Liaison—Dept. VAC-70
St. Paul, Minn.

Please send more information on ☐ CuCl₂[®] H807
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a single 4" Scotch Broad magnetic tape. It instantly permits you to scratch out those tedious minutes of recording time by offering the capability of recording and reproducing several band widths at significantly slower speeds. For example, you enjoy 12 minutes of recording time in the test range, cycle range running at 120 cps. You'll find that a perfect means for you like this in each of its 6 speeds. What need variations, by the way, are available to you in the most basic of a finger.

Our *Microsoft Director* proudly points to the fact that in addition to these inputs, the CMI 400 represents somewhat of a first in computing. It actually handles the work of two computers by merging both online and purchased web content. This means that *Fluor* homes its practically any information application for the industry or laboratory. For the full CMI-400 story, contact your local Microsoft representative or clip the coupon.

[illegible]

DRYLY VAC-70

Clack® JAWST
Heavy Duty
Utility Receiver
40...

Broadly speaking, the primary purpose of annealing is to soften steel and make it more workable. Annealing, as applied to alloy steels, may be defined as a process that heats above, and furnace-cools through, the critical range at a controlled, specified rate of speed, or that heats to a point within, and furnace-cools to a point below, the critical range. In either case, the choice depends upon the structure and maximum hardness desired.

The first method produces a lamellar pearlitic structure, while the second creates a spheroidized condition. Those will be discussed separately in the following paragraphs.

(3) *Lamellar pearlitic structure.* It should be mentioned at once that this structure can be obtained both as described above and by a modified method known as isothermal annealing. In the isothermal process, the steel is heated above the critical temperature (austenitized), then transformed at a predetermined temperature, which depends upon the analysis. This operation requires two furnaces or salt baths—one for austenitizing, one for transformation.

Lamellar pearlitic structures are generally associated with machinability in carbon ranges from 0.20 to 0.60 pct, provided the hardness does not exceed the optimum maximum.

Brinell numeral. This is especially true where critical tooling is involved. It is a very versatile structure, as it gives best results in such operations as broaching, tapping, threading, deep drilling, boring, reaming, and tooling as applied on single- and multiple-spindle bar automatic machines.

(2) **Spheroidised structure.** There are two general fields of use for this type of structure when alloy steels are employed. In the low and medium carbon ranges, spheroidisation is necessary for cold-chamber operations, such as heading, extruding, drawing. In the higher carbon ranges (over 0.60 pct), it is mandatory, where machining is involved, because it tends to lower the hardness of the steel.

If you want more details about these and other uses of annealing, and the results to be expected, by all means consult with our technical staff. And when you need alloy steels, Bethlehem can offer the full range of AISI standard grades, as well as special-analysis steels and all carbon grades.

This series of alloy steel adventures—now available as a compact booklet, "Quick Facts about Alloy Steels"—If you would like a free copy, please address your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

KNOW YOUR ALLOY STEELS . . .

This is one of a series of advertisements dealing with some facts about alloy steel. Through much of the industry there is a tendency to believe it will be of interest to many in this field, and having more of broad experience who may find it useful to review. Inconspicuously from time to time

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MINNESOTA MINING AND MANUFACTURING COMPANY
... WHERE RESEARCH IS THE KEY TO TOMORROW

MISSILE
INDUSTRY
PAGE 11

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
(Former Chairman) Bethlehem Steel Export Corporation

BETHLEHEM STEEL

17



He designed a new interchange for radio traffic

This AMP engineer, part of an AMP-318 Army team, solved the problem of traffic delays and personnel danger in manual reconnection of jumpers taken out of service by R.F. transmitters and antennas.

His solution is a push-button-operated, manual crossover switching system, using vacuum switches for current selection. A typical system consists of 4 transmitter inputs, 7 antenna outputs plus a dummy load, in a 4x4 matrix that can be mounted in a 15" rack. It can be controlled locally or remotely over any type of communication network having a bandwidth of at least 200 cycles.

AMP's manual crossover switching system provides 100% flexibility in circuit path selection and accommodates power levels as high as 500,000 watts and frequencies up to 50 megacycles. It allows 100% utilization of all transmitting equipment. Stiles is an aeronomically oriented.

To insure fast-ade operation, power is required for the vacuum switches only during change of conductance. Stiles rate 1 per second. Operating transmitters are safety-interlocked to receive a load. There are no known fire or open wire or radiation applications of power to back-lane antennas.

Single Command Concept

AMP's maintenance and skills are organized in a single operational unit offering a wide range of engineering and production capabilities. Its purpose is to accept assignments at any stage from concept through development, production, and service training, and to complete them faster.

- Ground Support Equipment
- Weapon Systems
- Modernize The force
- Radar
- Aircraft Handling & Processing
- Range Performance
- Space Environment Equipment
- Nuclear Research & Development

CENTREPOINT PRODUCTION GROUP,
AMP Building, 381 Madison Avenue,
New York 17, N. Y.



AMERICAN MACHINE & FOUNDRY COMPANY

July 16, 1960

Aviation Week

... Space Technology

Vol. 73, No. 3
Airbus: ASP and ABC

EDITORIAL OFFICE: New York 17, 123 W. 45th St., Phone (212) 633-2000. 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When crews of SAC's 1st Missile Division successfully launched the URAP ICBM Atlas from Vandenberg Air Force Base, September 8, 1968, the world became aware that the United States had brought into being a truly reliable intercontinental power for peace. Within four months after the first operational launch, the Air Force doubly underlined this nation's capability. On a single day, January 28, 1969, the 38th and 17th consecutive successful Atlases were fired within continental ranges to predetermined targets from both Air Force and Pacific bases.

After only two years of intense development, including concurrent research, testing and fabrication under this nation's top military priority, Atlas is extremely versatile as well as powerful. It will be the Project Space satellite vehicle and is scheduled for use in Project Mercury, the Titan in Space Program, and in other space exploration missions. Thus, used as a booster for space projects, Atlas provides the nation with a key capability in scientific as well as military applications.

Space Technology Laboratories provides the systems engineering and technical direction for the Atlas as well as other portions of the Air Force Ballistic Missile Program. Much of what was learned in building Atlas has helped out the lead time in the development of such other Air Force Ballistic Missiles as Thor, Titan and Minuteman.

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EDITORIAL

Missile Blackmail

Events of the past week following the U-2 episode and the Paris summit surfaced clearly: black, even, far-reaching into reducing the hole, only within of the Command threat to an insurmountable basis. Even the more pessimistic outlook of the international situation and we have found little more the situation as recent years, would hardly have dared to predict the sequence or the magnitude of the changes the master has achieved in its international relations.

Perhaps the conclusions of Nikita Khrushchev's attempt "bargaining" of the Moscow summit, his flight to intervene in the Western Hemisphere through Cuba, and the eventual announcement of a USSR-B-47 electronic reconnaissance plane in international airspace should finally enable the American people to see the signs on the horizon beyond of their threats and at long last accept our complex leadership to the fact that there are more competent events occurring than earlier round of golf.

Behind the scenes of shocking events and the effects that we seek to follow in the final outcome, here the fundamental fact that either through events or simply our national leaders have permitted a significant disparity to develop in the key elements of military power between the United States and the USSR. The missile gap of the 1960s was predicted in great detail by both military leaders and knowledgeable civilians. Its comparison was outlined with accuracy, that it was being suffered by events. Unfortunately this country chose to believe those who discounted the missile gap as a figment of civilian leaders' imaginations. In the final few years of the 1960s that remained for significant decades, we did little to ensure our survival during these perilous years of the Soviet. We are now in the midst of the missile gap. Its consequences are readily apparent. We are being subjected to the most brutal test of international blackmail—missile blackmail.

Mr. Khrushchev believes in his sufficient ICBMs to make effective his threats to blast any adversary with intercontinental rockets on a wide variety of preconditions ranging from the use of foreign bases by U.S. planes to the defense of U.S. bases in the Western Hemisphere from local aggression. To demonstrate the technical ability of his ICBMs, he has staged a series of test flights into a mid-Pacific region area where we have as little technical infrastructure to measure their performance in great detail.

At the same time Mr. Khrushchev has been demonstrating his ICBM capabilities, the USSR has been engaged in a costly program to enlarge and improve its air defense system. During the past two years new aerospace fighters with variable thrust power boost, new types of jets with greater altitude capability and new types of jet-engine aircraft have appeared in significant quantities increases in the Soviet air defense system.

It is dangerous that suddenly in the USSR extend the destruction of the USSR-B-47 even though it was still in international airspace. After the announcement of the U-2 penetration the USSR had needed a convincing public demonstration of its air defense capability just as it could the Pacific missile tests to prove its competence in the ICBM field. In his press conference Mr. Khrushchev went

into considerable and reasonably accurate detail on the technical performance of the B-47 and pointed out that this type is the largest element in our strategic bomber fleet. Then he said the destruction of the B-47 by Soviet fighters to make a point that U.S. strategic bomber strength is as obsolete as the B-47 on which it depends.

Thus Mr. Khrushchev has publicly established the two vital elements he needs to practice missile blackmail on the United States and its allies—a reliable ICBM capability with acceptable accuracy over 5,000 mi. ranges and an adequate system designed to prevent the loss of SAC's command bomber fleet from penetrating the Soviet Union on a retaliatory mission.

These are weapons that, properly applied, would pull the rug from under Mr. Khrushchev's carefully constructed missile blackmail techniques. A counter ICBM force of offensive war designed and based on solid attack by our defense system. Equipment of the SAC bomber fleet with the latest day-to-day ground missile would also make a mockery of the air defense system by making great penetration corridors long before other fighters or sub-orbital missiles could reach the attacking bombers. A B-52 fleet equipped with Hovey Dags and supported by excellent jet tankers and other equipment to maintain an airborne alert would trump most of the cards in Mr. Khrushchev's current missile hand.

However, these vital elements do not exist today in the operational control of Strategic Air Command. Regardless of what new suggestions have been created by Administration leaders' speeches, none of these weapons are in operational use today. They won't be for some months and in some cases for years to come. What have we done to accelerate the production and equipment of our strategic forces with these weapons? Precious little! They have all been proceeding at a relatively leisurely pace, dictated primarily by fiscal, not military, considerations—a pace based on the premise that no real Soviet military-technical threat exists.

Our failure to provide SAC with the air-to-ground penetrators needed and augmented B-52 and jet tankers fleet, the supersonic B-48, and a truly significantly sized and manned Atlas and Titan program—all at least as possible—has cost and will cost us far more in terms of the country's future than the monetary price of these missiles, no matter how qualified their production management might have been.

Now will the USSR stop with missile blackmail. If and when we make the necessary effort to boost our strategic forces into competitive parity or superiority, we can expect the Soviets to move their blackmail technique into a new technical non-air space. Satellite blackmail is extremely easy on the Soviet timetable and it is the missile blackmail because technically and diplomatically obsolete.

President Eisenhower has warned the Soviet Union that continuation of its current policies toward the country will result in "serious consequences." Even Americans will look forward to the emergence of United States policy designed to stop missile blackmail and the eventual flight of America's air crews in international airspace.

—Robert Thoma

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38401	amplifier, switch, control	500-100 mW	low noise, high speed
38402	amplifier, switch, control	500-100 mW	low noise, high speed
38403	amplifier, switch, control	500-100 mW	low noise, high speed
38404	amplifier, switch, control	500-100 mW	low noise, high speed
38405	amplifier, switch, control	500-100 mW	low noise, high speed

SADT... SILICON SURFACE ALLOY DIFFUSED-BASE TRANSISTORS

	APPLICATIONS	TYPE (MIL)	SPECIAL FEATURES
38406	amplifier, switch, control	500-100 mW	low noise, high speed
38407	amplifier, switch, control	500-100 mW	low noise, high speed
38408	amplifier, switch, control	500-100 mW	low noise, high speed
38409	amplifier, switch, control	500-100 mW	low noise, high speed
38410	amplifier, switch, control	500-100 mW	low noise, high speed
38411	amplifier, switch, control	500-100 mW	low noise, high speed
38412	amplifier, switch, control	500-100 mW	low noise, high speed
38413	amplifier, switch, control	500-100 mW	low noise, high speed
38414	amplifier, switch, control	500-100 mW	low noise, high speed
38415	amplifier, switch, control	500-100 mW	low noise, high speed

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Washington Roundup

ARPA Shuffle

Under Inter Pentagon organization change the Advanced Research Projects Division of the Institute for Defense Analysis (IDA) will now provide technical support directly to office of Dr. Herbert York, director of defense research and engineering instead of sub to Advanced Research Projects Agency as previously. Division is now called Research and Engineering Support Group with William Bradley as acting director. The shift is another move which suggests that ARPA and its functions are gradually being absorbed directly into Dr. York's organization.

Administration still has not indicated how much it will spend from the extra \$700 million in defense funds voted by Congress above President Eisenhower's requests. But Defense Secretary Thomas S. Gates, Jr., now says he is "not sure that we would want to see some of them to expedite some of the weapon systems we have on the way."

There have been signs that the Budget Bureau might not release the extra funds and it is certain that the bureau would like to see at least of the \$700 million spent in 1962.

What Defense plans to do is to take the extra money into account in its plans for Fiscal 1962 budget—along a little less than it would have if Congress hadn't added the new money.

Gates points out that the increase was only about \$300, and says that "anybody the position that the Administration has taken that that is an adequate defense [budget] and appropriate to secure our national posture over the years ahead."

Although New York Gov. Nelson Rockefeller wants the nation to spend another \$3 billion for accelerated defense needs, Gates says there is no difference between Rockefeller and himself in the fact that they both believe "we should be strong and we should lead from strength in all our foreign policy problems." As far as the \$1 billion difference, the question of size of the budget is a matter of judgment, Gates said.

On the question of U. S. military bases abroad, Gates believes that the nation now is doing a good job of maintaining alliances and friendships in spite of what he called "troubles that break out because of well organized minorities."

U-2 Flights

Despite official statements here that no Lockheed U-2 reconnaissance aircraft are being sent to the Western Hemisphere, Moscow continues to ask such nations to make that U-2 spy flights in the Middle East are still going on.

Most recent Russian broadcast used the device of quoting Greek and Egyptian newspaper reports. The Greek paper said "the American U-2 in detachment is now completely devoted to covering our military activities against Arab countries. It is this program, American aircraft use, the military base in Turkey, India and Saudi Arabia."

A Cairo weekly said that U.S. U-2s had caused one aerial spy flight over North Africa during May. Russian broadcasts make the point that the flights go on in spite of Soviet warnings and even though President Eisenhower said they had been stopped. This time reports end with a long Communist condemnation against the use of force from the U. S.

Russia also continues to insist that U-2s are based near the city of Alton Springs in central Australia. Then an Air Force Minister Morgan has said that the base is used only for meteorological observation, but says that in the Washington corridors, meteorological is synonymous with espionage.

Space APU

Air Force Scientific Advisory Board has formed a new committee on non-propulsion space power to provide technical guidance both to USAF's chief of staff and to the Director of Defense Research and Engineering. The group will survey state of the art and Defense Department programs in space power energy conversion and make recommendations for improvements when required. The committee co-chairmen are Dr. Arthur S. E. Jones, University of California, and Dr. E. E. Jones, who heads E. I. du Pont Research.

Senate Panel on Foreign Relations Subcommittees has concluded that successful development of a manned weapon system such as the North American A-70 Mach 3 bomber could advance development of a supersonic transport and would be an important step in the program of controlled flight. This report is further statement by the House Committee on Science and Astronautics that the future of a U. S. supersonic aircraft is closely linked to the B-70 program (A-70, p. 3). House group urged National Aeronautics and Space Administration to assume a leading role and produce a definite plan for developing a U. S. supersonic transport.

—Washington Staff

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RB-47 Leads to Exchange of Warnings

Washington—Shooting down of a USAF RB-47 reconnaissance bomber by Soviet Russia over the Barents Sea on July 1 produced a warning from Russia last week that the U.S. and its allies are "provoking serious military conflict" by continuing espionage flights, and a counterwarning by the U.S. that operations of such "unjustified action" as the "hostile attack" on the plane (AWN July 16, p. 12) are international actions which will be met with serious consequences.

Russia announced on July 11 that a Soviet fighter had shot down the Strategic Air Command RB-47 at 11:47 on June 30 near Sverdlovsk (now Gorky) after its first sighting reporting the RB-47 to land near Gorky.

Russia said it had captured the cockpit and console and would transmit the data to all units of Soviet land, sea and air forces. It said the body of the pilot is a life raft. It did not account for three other crew members except to say that they were trained as pilots and electronic engineers.

In a strong note of protest to the U.S. and its satellites by Premier Nikita Khrushchev, Russia linked the flight to espionage flights of the Lockheed U-2 and had Soviet engineers the aircraft Russian theme that the U.S. is using foreign bases for "provocative" flights that violate Soviet territory.

Khrushchev said the government wanted 10 days to send a life raft and period. To see how the American side would exploit the disappearance of the plane.

We had tipped them on the flight. I believe Russia dropped a U-2 over Sverdlovsk. We waited for them to see their agent on July 1. And in a dozen days we received it.

The U.S. announced shortly after

the plane disappeared that it had taken all the down from the aircraft in a flight to survive the early magnetic field in order to map mining.

The plane's position was last reported on July 10, south of Kamchatka Peninsula and 270 mi. west of the Russian island of Novaya Zemlya, and there was no deliberate violation of Soviet territory, the U.S. said. A week's search was opened immediately from the aircraft at Bodo in northern Norway, the same base where Russia said was to be the terminal point of the May 1 flight at the U.S. flag and Navy. The Soviet state is quoted that Defense Minister Marshal Rodion Malinovsky had not caused the search because it was to be a search for the aircraft and not to be a search for the aircraft.

The U.S. state "admits and regrets" that the aircraft was shot down by a Soviet 10-day search, and that the U.S. aircraft did violate Russia's borders because the mission "was stopped in its early stage." Asked how it developed this, Khrushchev said:

"I can only say that I understand it. The Soviet Union has stated. When and how the warning will be put into effect—on the issue the Defense Minister has been given fairly precise instructions. He is in a position to make a decision by the next hour."

Khrushchev admitted 500 correspondents at a press conference in Moscow. The plane was shot down by a Soviet fighter. "Should we not make it clear to you that the U.S. aircraft did violate Russia's borders because the mission 'was stopped in its early stage.' Asked how it developed this, Khrushchev said:

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flight was "entirely different in character" from the U-2 flights, and that 10 years' observation to the crew might require that the aircraft remain well outside the airspace of Soviet territory."

The U.S. demanded release of the cockpit, the body of the pilot, and the wreckage. In July 1951, John F. Kennedy—writing it did not do in the case of U-2 pilot Francis G. Powers—demanded that the U.S. immediately release the cockpit and the body of the pilot. It also demanded access to the body of the pilot, Capt. William A. Davis.

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its refusal to handover of the U-2 accident by the U.S. government, state agents of the RB-47 crew have been located almost entirely to official documents such as the Defense Department's report and the statement by President Eisenhower that have been published in the United States of their Christian Hosts.

Passage against U.S. after one hour from the U.S. state, was left mostly in Britain, where the Labor Party has been pressing the Conservative for disclosure of what rights the U.S. has towards Russia. Mr. Harold Macmillan replied in July 1951, that President Eisenhower "has questioned whether there should be any modification or suspension" of current arrangements.

Second day before the RB-47 was downed, Khrushchev said that Soviet leaders "are not at all satisfied" with the U.S. state, and that the U.S. state "admits and regrets" that the aircraft was shot down by a Soviet 10-day search, and that the U.S. aircraft did violate Russia's borders because the mission "was stopped in its early stage." Asked how it developed this, Khrushchev said:

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Reds Down 17 U.S. Craft in Decade

Washington—The recent RB-47 accident brings the total number of U.S. aircraft shot down by the Soviet Union over the past 10 years to 17 and the number of aircraft downed in missing from these flights to 35, Kenneth K. K. N. N. and last week.

During the past 10 years, the U.S. has lost 17 aircraft to the Soviet Union. The first was a B-29 bomber shot down by a Soviet fighter in 1945. The last was a B-29 bomber shot down by a Soviet fighter in 1951.

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by two Soviet jet fighters while conducting a routine flight over international waters in the Barents Strait, June 22, 1955. The FIV was so damaged that it was forced to land on the island of Novaya Zemlya, U.S. territory. The crew remained in U.S. custody.

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Democrats Pledge Reorganization Of Military and Space Programs

By Paul Hutzman

Los Angeles—Democrats, at their national convention here last week, announced changes that the Republican Administration has allowed the national military posture and transportation system to decline and has failed to bring into the importance of space technology.

At the same time, the party pledged to eliminate military, space and limited non-race, scientific programs for missile and space projects, support here and applied research and to expand on safety programs to accommodate growth on traffic.

In a strongly worded platform adopted at the convention, Democrats have these charges:

- "Over the past seven and a half years, our nation's power has steadily declined relative to that of the Russians and the Chinese and their satellites."

- "The Republican Administration has renounced its leadership in the prospects of space exploration. They have failed to pursue space programs with a sense of urgency anywhere near the equal to their importance to the future of the world."

- "The Republican Administration, during its glowing promises of 'space for peace,' has permitted the gradual decline of America's leadership in strategic defense technology both at home and abroad."

- "Over the past seven years, we have witnessed the steady weakening of the nation's transportation system. Roadways are in disrepair. Highways are congested. Airports are always late for behind the needs of the jet age."

The platform committee, headed by Rep. Charles Bennett (D-Calif.), said the party objective is not the right to co-exist in armed camps on the same planet with totalitarian ideologies, it is the creation of an industrial power base which the universal voice of human dignity, truth, and justice under law are secured for all men.

"If America is to put effectively the use of space, the country and, we must first reduce our national strength—military, political, economic, and moral."

The platform calls for a retraining of U.S. military equipment in order to "provide forces and weapons of a dynamic balance, and mobility adequate in quality and quality to deter both limited and general aggression."

It also calls for the strength that must be "corrected," the Democrats said.

- "Detest military power such that

the Soviets and Chinese leaders will have no doubts that an attack on the U.S. would surely be followed by their own destruction."

- "Eliminate conventional military forces which will permit a response guided by the intensity of war through of aggressive force."

- "Continuous accommodation of these forces through increased research and development, including essential programs now slow down, truncated, suspended, or neglected for lack of budgetary support."

A far more radical business of a Democratic Administration, the platform pledged, would be a re-examination of the organization of the armed forces.

"An military organization structure, currently being developed, is war on 'jingoism,'" it said, "cannot be suitable for the strategic defense, contractual defense, limited war, and other defense requirements of the 1960s." "We must, therefore, create a platform, and that our armed forces should be organized more acutely on the basis of function, not only to produce greater military strength, but also to eliminate duplications and save industrial costs."

To meet the transportation problem, Democrats pledged themselves to the establishment of a national transportation policy, designed to coordinate and modernize technology and transportation by road, rail, water and air.

"The party has made rapid improvement in its safety perspective," the party platform said. "But this is not an adequate basis for the current great programs proposed by the Republican Administration, nor pledge to equal the progress to accommodate growing traffic."

The platform also promised to develop solid infrastructure and authority, support the principle of federal-state partnership in highway construction, "and encourage the use of federal funds to support federal assistance in meeting capital needs for value mass transportation. The platform and the Republican space program is a "tandem" of a national program with a clearly-defined, long-range policy of research."

At the same time it promised a Democratic Administration would press forward with a national space program to "aid realization of the importance of space technology to our national security and our international prestige."

The platform promised to reorganize the program to achieve both efficiency and security, creating a strong team approach for the protection of transportation and essential long-range basic research.

in space research and population. In order to "control United States leadership" in space development, the platform promised a new Democratic Administration would do the following:

- "Reorganize the space program to give our administration of the void some energy program."

- "Accelerate the Soviet nuclear rocket project and develop power facilities to aid in achieving world leadership in peaceful outer space exploration."

- "Continue the development of the various promising experimental and prototype space power plants which show great promise and progress towards their large scale projects in the forefront of science energy application."

- "Continue to preserve and support national laboratories and other federal research facilities in the foundation of technical progress and leadership of national defense."

- "Give priority to U.S. international space for peace programs and to continue to develop greater than 30,000,000 m. it has concluded that Dr. A. C. R. Lovell, director the Jodrell Bank Station, called "some of the most remarkable discoveries in science."

Great bulk of data from the Pioneer V has been provided by a 5-foot telescope and received by the 250 ft Jodrell Bank antenna. The first at least to space a 150-watt transmitter on May 8 when the probe was eight million miles from earth, was successful but landed on a rock made of the stratosphere.

- "Provide a balanced and flexible research defense capability, including the augmentation of the nuclear submarine fleet."

With respect to the regulatory system, the platform and the Democratic Party declared that the executive of the power and functions of the independent agencies and protects the constitution of the independence of such agencies and the protection of the integrity of the office.

The platform and a Democratic Administration would bring full contact with communications into the open and will protect them from any form of interference. The platform promised to support the role of these agencies of ability and independent independence who understand that their function is to regulate the free enterprise system in the public interest in addition, the platform promised to review agency positions with an eye toward speedier decisions and a closer definition of what constitutes the public interest.

In regard to national policy matters, the platform said that the National Security Council has been used and to focus more for decision by the responsible leaders of government, but to support the principle of a national security system which can make decisions.

The platform said it welcomed the study now being made by the Senate Select Committee on National Policy Matters, headed by Sen. Henry Jackson (D-Wash.).

NASA Cites Data Gained by Pioneer V

Washington—Pioneer V space probe is silent after an unprecedented explosion of interplanetary space that provided 144.8 m. of scientific data from up to 22.5 million miles from earth.

The 94.5 lb. probe, launched Mar. 11 into a heliocentric orbit that will carry it about the orbit of the planet Venus made its last transmission at 7:11 a. m. EDT on June 25.

The probe was then 23,627,748 m. from earth, traveling away from the Jodrell Bank radio telescope near Manchester, England, at a relative velocity of 15,621 mph. It had transmitted 62.5 m. the distance from the orbit of earth to the orbit of Venus and sent 739 m. data less on the course of the trip.

Although Pioneer V did not fulfill signals hoped that it would transmit even distances greater than 30,000,000 m., it has concluded that Dr. A. C. R. Lovell, director the Jodrell Bank Station, called "some of the most remarkable discoveries in science."

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Times Querying Steps

Washington—Times newspaper queried weather satellite, which transmitted 22,952 photographs from its orbit from its 490 m. orbit since it was launched last Apr. 1, no longer is being heard.

Interpretation was suspended temporarily last 17 after some 280 m. of camera operating time. Although it transmitted on June 16 and 17, it was concluded that the satellite's camera was operating, but was in an orbit, "No final decision was made by the National Aeronautics and Space Administration."

NASA speculated that as cooperative work in the solar wind, solar wind prevented moving that means of the "spacecraft" downed battery power and found out the camera's transmitter. Although "some limited operational capability" remains in the near-term mission status. Field attacks, some are not working and without adequate information in radio-range photo it is almost impossible to identify and locate the probe.

More than 60% of the 5,137 narrow-angle shots, 17,817 wide-angle shots produced good quality data on photo used to meteorological research, NASA said.

transmitter because of apparent distortion of the probe's 35 batteries (AVR Mar. 16 p. 14).

At a press conference called to honor Dr. Lovell for his and the United Kingdom a part in tracking U.S. probes, and to reveal the results of Pioneer V's flight, National Aeronautics and Space Administration's Director of Space Flight Programs, the following results were given:

- First quantitative mapping of the interplanetary magnetic field. Evidence of such a field had been indicated by theory and by earlier interplanetary probes, but it was not clearly established during the Pioneer V flight. Silverstein said.

The field data in interplanetary space was associated with the solar flowing streams. He said that the probe was in the line of the intersection of the solar wind and the geomagnetic field. The field strength at least was 61,000 m. and the interplanetary probe indicates in interplanetary space.

- First quantitative measurement of the solar wind. The probe's first orbit was 22,952 m. from earth and it was 15,621 mph. in distance. Current flowing westward in the region is contained at 1.5 million pounds.

- "Discovery that the Fockner domain, which is a measure of the decrease in the cross-section of the magnetosphere of a solar field, is which, as an atmospheric phenomenon and not associated with the field around the earth."

- First measurement of the surface of the solar wind on the Van Allen belt.

First measurement of the use of the solar system by means of a space probe. Soviet Russia's Lenz, it was launched only to 790,000 m. and the radio NASA says, Pioneer IV only to 447,000 m.

Details of some of these scientific contributions had been reported earlier to those who developed the pioneering interplanetary (AVR Mar. 3, p. 12).

Throughgoing, the probe established the position of the solar wind and has maintained control over an interplanetary vehicle achieved the greatest velocity of any man-made vehicle, and enabled the first use of an interplanetary probe, guidance system, Silverstein said. Pioneer V carried the elements of a guidance system. Silverstein said, "It is that had the probe's guidance system, which is a very important part of the probe's active life, when the batteries would be recharged."

then energies."

Internal and external measurements were associated throughout the flight. Temperature of the four solar cell paddles averaged 21F above 15 m. by about 100 m. Three probe units, and the probe mass 15,000,000 m. from earth, profile temperatures averaged 10° below 100 m. on the inside side of a shell facing the sun of the probe and one 100 m. on the flight in the sun.

The payload was developed for NASA by Space Technology Laboratories Inc. and launched with a Douglas Thor-Able by Dr. Francis B. Roberts, Mission Director and STL (AVR Mar. 3, p. 10).

Despite plans for inter probe U.S. U.S. space programs, Lovell said that some of us as far as possible, one of a separate British space program "if we can do it, we can do it as a common technological system."

Further development of the Blue Streak and Black Knight rockets with space probes for three or more place de-orbiting and in the future, he said, that "will not be forced if we merely have to interplanetary American payloads." Lovell said. Deepening rocket development, for the sake of a few million pounds, because a relative decision has been made not to use rockets "would be a gross error" because the whole vehicle strategy is dearth of the phase of being transformed. And at the moment, his own view is that we should be in the next one or two decades."

Lunar Vehicle Studies

Five companies have been selected for development studies leading to a program to test landing of an instrumented space probe on the moon, as follows in the National Aeronautics and Space Administration's Ranger program (NASA) for Propulsion Laboratories awarded the contract.

The contract is Hughes Aircraft Co., Culver City, Calif.; North American Aviation's Mission Division, Dallas, Texas; McDonnell Aircraft Corp., St. Louis, and Space Technology Laboratories, El Segundo, Calif.

Each contract will work independently on a study, to be submitted by Feb. 1, December, to establish design, size, weight and optical stability of the instrumented lunar probe.

The last landing vehicle is scheduled to be launched in an Atlas rocket. The lunar Ranger land landing program is scheduled to land a reconnaissance on the surface of the moon sometime in late 1963 or early 1964, on impact vehicles of less than 500 mph.

House Unit Urges Establishment Of National Ocean Study Program

Washington—House Science and Astronautics Committee has called for a vastly expanded national effort in oceanography to meet the Soviet submarine threat and to exploit the untapped resources of the sea. The committee opened the door to formation of a new federal agency to plan and coordinate all ocean research beginning next fiscal year.

In a 400-page staff study on "Ocean Sciences and National Security," the House committee this week of the ability and scientific research currently engaged in oceanography have gained effective research programs. The study particularly scolded Navy's lack of an agency to plan ocean research, despite its importance in national defense, and suggests that an expanded program be concentrated more in civilian agencies.

The study emphasizes the need for an urgent national program on oceanography, possibly to better understand the medium in which the long Soviet submarine fleet operates. The ocean also is viewed in space as an area with great scientific and propaganda value.

Navy's Interest

Navy's immediate interest in oceanography is concentrated in understanding sea phenomena in that, sufficient attention is devoted to tracking underwater targets. Specific areas affecting ocean operations not previously known are

ambient noise from winds, surface roughness and noise from reefs and coral, temperature gradient salinity, biological organisms and related noise, deep oceanic particle effects on long range beams, slope roughness, and bottom composition, and ice thickness and roughness.

Program Costs

In the past three years studies on long-range national programs have been conducted by the National Academy of Sciences Committee on Oceanography (NACOS), Intelligence Committee on Oceanography (ICCO) and the Navy, which calls its program TT-NOC for 10-year program on oceanography.

NACOS recommended a 10-year program of \$807 million with an annual cost of \$68 million after 1969. This program would include routine tests of 78 new ships and provide \$15 million to create oceanography.

The ICCO 10-year program would cost \$1 billion with annual cost leveling off at \$85 million after 1969. The ICCO proposal includes 75 new ships.

For the current fiscal year, NACOS recommended a budget of \$56 million and ICCO \$125 million to support oceanography. Requests for government agencies (Navy, Department of Commerce, Department of the Interior, National Science Foundation and Atomic Energy Commission) totaled \$95 million. Congress appropriated the full amount requested.

The 10 research fleet consists of 60 vessels: 52 research oceanographic and 15 hydrographic. Among ships of these vessels, 15 are, and all but 15 are scheduled to be replaced by 1970.

Navy's TT-NOC program, which includes both basic and applied research in contrast to government and industry. It is a \$75 million program for 18 research ships and new laboratories. In-house operating budget under this project would total \$113 million over the next 10 years.

The House report urges the Navy to increase its emphasis on deep-diving submarines and hydrographic research since the current depth limit of submarines is 708 ft. Because of the danger, reports in placing in oceanography, a deep-diving vehicle is considered a priority (SOS) development.

The report states that 65% of the ocean is more than 12,000 ft. in depth and 90% is more than 15,000 ft. deep.

Removal Metals Co. is constructing a submarine, 55 ft. in diameter, capable of operating at 15,000 ft. depth and will make the craft available to the Navy.

The "Albatross" was designed at Southwest Research Institute under a proprietary Navy study program.

Navy would use the craft both for oceanography as well as for research in submarine hull design, propulsion and controls.

Sen. Douglas Scores Defense for 'Waste'

Washington—Sen. Paul Douglas (D-Ill.) last week lambasted a major component in arms that he charged was wasteful practices in Defense Department procurement by focusing on the extreme prices paid for oceanographic items.

He has referred approximately 1,000 small procurements for which Defense allegedly paid exorbitant prices to the General Accounting Office for thorough investigation.

Douglas' move was backed off by a 16-page Defense Department disclaimer, stating that it made no in Senate speech June 11 charging excessive pricing of 16 items. These included:

- Cable transfer which Air Force paid about \$10.67, and which is now being sold commercially for \$5.15.

- Defense explained the equipment was specifically designed for US-MF requirements.

- Wrench set for which Douglas and Army paid \$23 and which General Services Administration sells for \$4.95. Douglas and Army has purchased some of the sets since World War II. The item deployed by Sen. Douglas was declared surplus by National Security Agency in 1958 and a price for record purposes was then established at \$29.

Douglas stated "As an Army machine screw has been taken on that item since World War II, the actual purchase price is not available as it is probable amounts have been diverted."

- Lamp socket for which Navy paid \$21.35, and which Douglas had proposed at 74 cents. Douglas and that Douglas' information was "erroneous" because "a closed item was made in applying the price and stock number of a complete lamp holder assembly, including the socket, to the socket itself. This price of \$21.35 was never paid for the socket alone."

Douglas contended that "there is no evidence of its having paid excessive price" for one of the 16 items named by Douglas. Douglas responded that the statement assumed that "Defense will not admit making a single mistake with respect to their procurement and supply practices but shamelessly defend their practices." He referred the 16 items, along with the 1,000 additional items, to General Accounting for investigation.



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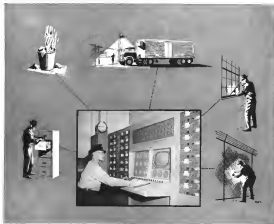
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Satellite to Test Orbital Network Plan

By Philip J. Klass

Washington—Within several years, Bell Telephone System plans to place an experimental space communications satellite in orbit. The formation of a commercial space communications network, which can ultimately span the globe and provide 600 two-way voice channels and one television circuit. Cost of the global system is estimated at around \$100 million.

Global coverage is based on placing about 10 regular satellites in random orbit at an altitude of 1,000 mi. American Telephone & Telegraph Co. already has had preliminary discussions with several governments including rocket booster manufacturers, which have proposed to launch the satellite launch.

The company's current plans and funding are considered communications satellite systems without a few feasibility issues discussed in recent written testimony filed with the Federal Communications Commission. The Bell System statement, and the views of 17 other companies, organizations and government agencies, were in response to the FCC's request for views on objectives of frequencies for space communications in connection with its Order 11560, dealing with spectrum allocation above 592 megacycles.

Lockheed Aircraft Corp., another respondent, said that technology has advanced to the point where it is possible to provide an operational space communications (satellite) system for voice communications between Western Europe and the Western Hemisphere within three years from decision to proceed.

Radio Corporation of America reported it believes that a commercial satellite communications system capable of transmitting television pictures between U.S. and Great Britain could be made for trial commercial usage by 1965, with extensive international systems operational by 1970.

Discussions that commenced in FCC were in general agreement that space communications systems appear to offer more attractive operational and economic advantages, compared with existing telephone cables and radio communications, but differed sharply over frequency allocations.

American Telephone & Telegraph Co. (Bell Telephone System) again noted that FCC reconsider last year's decision to allocate frequencies above 600 mc. for private enterprise voice and television systems in view of the recently developed needs of space communications systems. This position was reported also by General Telephone &

Electronics Corp. The AT&T position is that unless that is done, the frequencies required for a communications satellite system will be taken by other services including private enterprise systems. The other seriously noted weaknesses of space communications before or after it to share bandwidth with the other services and result in mutual interference between services.

The Electronic Industries Assn., and a number of electronic manufacturers, also sharp issue with AT&T. Their view is that the two types of services can share common portions of the spectrum without electronic interference. FCC is scheduled to hear oral arguments in representative of opposing points of view this week.

Bell Telephone System studies indicate that a space communications system consisting of about 50 orbits, representing satellites, placed in an elliptical orbit at an altitude of 3,000 mi., could provide direct communications between the U.S. and all other parts of the world, without using intermediate facilities of other countries. Service would require 15 transatlantic installations, started on the U.S. and in six spots around the earth.

Based on the rate of a launching vehicle such as the Atlas-Agena with payload capacity sufficient to launch several satellites in a single launch, AT&T studies indicate it will cost to launch 5100-200 and 54 vehicles for each satellite placed in orbit. Figure includes cost of building satellite launching vehicle and launch facilities rental. In estimating overall system cost, the company used a figure of 51 vehicles per satellite in orbit. If the satellite is to provide one television channel in addition to 600 two-way voice circuits, the cost would be roughly double. Estimates for the 20 ground conferences is about \$1.5 million daily. This brings total global system cost for 20 ground stations and 50 satellites with telephone circuit capabilities only, to around \$115 million, or about \$115 million if television circuit also is included.

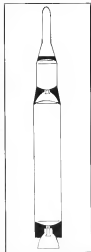
A major system, providing 600 voice circuits between Honolulu, the U.S. and Western Europe, would require only 10 satellites and eight ground stations, for a total cost of 500 million AT&T estimates. On a per-circuit basis the company says the space communications system would be "substantially lower than cost of the best, now off-the-shelf submarine cable, now under design, which still is less expensive than cables now in use."

This cost comparison is based on an average circuit life of 10 years for the satellite payload, at a 1,000-mi. orbit

the satellite itself would have a far longer life.

Experimental communications satellite now under design by Bell Telephone Laboratories is expected to weigh about 110 lb. and measure about four feet in diameter. It will be powered by solar cells and chemical batteries.

The planned space communications system is expected to be a part of international treaties.



New Rocketdyne Nozzle

Shortcuts of the "transverse-diffusion" design, developed by Rocketdyne allows reduced submergence erosion and up stream weight savings in use on upper stages of multistage vehicles (AV June 6 p. 115). Nozzle was not developed for a particular engine, but will be applied to new engine concepts.

Trunkline Traffic Falls Below Predictions

Prospect of reaching 14% gain originally forecast for 1960 seems slight in view of slack first half.

By L. L. Dots

Washington—A sharp dip in trunkline business during the first half of 1960 from last year's traffic growth trend has created an atmosphere of pessimism over prospects of reaching the 14% traffic increase originally forecast for the year.

Although the 12 domestic trunkline carriers registered a 7.6% gain in passenger revenue miles during the first six months, the increase was disappointing in view of the healthy business conditions prevailing during the period. In addition, growing concern among business analysts that the pace of the economy may be slackening is casting some question over the airlines' chances of recovering sufficiently during the balance of the year to meet even close to 1959's impressive 15% gain in revenue passenger miles.

Kaiser Commerce Department forecasts of an overall \$120 billion gross national product—support of all goals and services—the end of the year will probably be revised shortly to \$106 billion. An original forecast set by Aviation Week (AW) Feb. 29, p. 30, airline traffic analysts closely parallel the peaks and valleys of the gross national product after seasonal adjustment have been made.

Thus the gross national product serves as an indicator in predicting seasonal growth trends of trunkline business. The 14.7% gain forecast for the year 1960, suggesting that some 15.5 billion revenue passenger miles should have been accumulated by June 30, was based on the predicted \$110 billion annual gross national product.

In addition, the month of June, his-

torically the first of the summer's peak months, showed a revenue passenger mile gain of only 3.4%. Last June for the month was 66.8%, a seven-point climb over the May load factor, but a five-point decline from last June's level.

Another significant pattern which emerged during the first six months of 1960 and which threatens to change the entire complexion of the domestic trunkline industry is the narrowing gap between coach and first-class traffic.

During the month of June, coach revenue passenger miles climbed to 1.15 billion to equal the 1.15 billion first-class revenue passenger miles posted in the same period. It is the first time in airline history that coach traffic has equaled first-class traffic in volume.

Coach Traffic Trend

Furthermore, during the first six months, first class revenue passenger miles totaled 7.74 billion—no change from the 7.74 billion generated in the first six months of 1959. However, coach traffic climbed 15.6% in the same period to reach 6.78 billion revenue passenger miles. It is strongly expected that, if the trend continues as it is expected to be, coach traffic will soon outstrip first class traffic to be-



Minuteman Railroad Car Suspension System Tested

Minutemen railroad test car is used to evaluate the protection afforded the satellite by the aerial spring suspension system. Instrumented car carries a dummy simulating actual Minuteman load characteristics and is subjected to a variety of impacts exceeding those a satellite train might encounter. Car will be used to test following vehicles at the Research, P. I., plant of American Car and Foundry Division of ACF Industries. ACF and American Works and Foundry Co. are developing satellite car and associated car for Minuteman trains.

NASA Approves Ryan Vertiplane Project

Ryan Aeronautical Co. has been authorized by National Aeronautics and Space Administration to rebuild the Ryan VZ-1K1 Vertiplane which crashed on a test flight earlier this year (AW June 25, p. 91).

The tilt wing VTOL plane had completed 21 successful flights prior to the crash, which followed a steep pitchback through 180 deg. Ryan originally developed the Vertiplane for U. S. Army under sponsorship of Office of Special Research. Final reusable test will be

done by NASA personnel at Ames Laboratory, Moffett Field, Calif., where flight testing will be resumed.

In another VTOL development, Vought Aircraft and Marine Corp. built one of the Vought DC-3 fan wing now completing tunnel tests at Ames (AW Oct. 19, 1958, p. 128), and it will re-install a Livestock T31 turbine on the plane under a cost reimbursement contract from Wright Air Development Division.

Edward G. Vandenberg, Vought president, said the turbo-powered Vought will undergo testing tests next October and then be returned to Ames for further testing. Vought shareholders have approved a merger with Northeast Metals Industries Inc., Philadelphia, Pa., following director approval (AW July 11, p. 145).

board flight was lifted and all other resumed.

Stockholders of Long Aire Electronics Inc. and Trans-Aircraft Corp. voted in favor of merger.

Minutemen Institute of Technology will construct a world's most powerful magnet, part of new Magnet Laboratory to be built under a \$9.5 million contract from Air Research and Development Command, for laser research in magnetic fields and three effects. Magnet will produce continuous magnetic field with strength of 250,000 gauss, 500,000 times the strength of the earth's magnetic field.

Boeing Airplane Co. received formal \$247 million USAF Minuteman contract to revise research and development through 1962.

Westland Westinghouse prototype helicopter made its first flight last week with a six-bladed rotor head.

News Digest

Richard E. Horner resigned as assistant administrator for National Aeronautics and Space Administration to become senior vice president for technological matters at Northrup Corp. effective July 15. USAF Col. Douglas H. Hagan, Horner's special assistant at NASA, is leaving the space agency to attend the National War College.

Atair-Stratagems project continued last week with three live-range studies conducted from Walling Island, Va., to measure electron densities up to 1,300 mi.—altitudes where Nike Zeus will intercept ICBMs.

Detaching of a Northwest Orient Aerlin Douglas DC-3 last week, which the Philippine Airlines followed the reported loss of a propeller and wing fair. One of the 55 percent closed the Manila

Terrene-Missile Contract

Washington—Newly signed \$15 million research and development contract with Arme Division, American Rocket Corp., for Navarone-based rapid Terrene missile system.

Texas is under to Arme Division Alpha but lighter and more compact Alpha weighs 300 lbs. and has range of 900 ft. It has been in flight since early 1959.

Contract calls for modification of existing fire control equipment and system integration for first test of the Terrene. New facilities are required for the analysis, which was developed by Strangways Defense Research Establishment and is subcontracted to Knappley Vapour Ltd.

First Half Traffic

Actual revenue passenger miles during the first six months of the year in the trunkline reached an annualized 14.44 billion by June 30. Annual gross national product at the end of the second quarter was \$105.5 billion, according to President Eisenhower. Although this was a \$1 billion loss over the first quarter of 1960, the increase fell short of the \$107.7 billion jump in the annual gross national product at the end of the first quarter over the previous three-month period.

Consequently, the dip in the annual rate is reflected in a weakening of revenue passenger miles. On the basis of this change in the economic picture, it is now forecast that revenue passenger miles will reach 30.7 billion by the end of the year compared with the 28.1 billion from 1959.

A further reduction of traffic trends thus far this year is shown by the ques-

American Electra Modification Program

New York—American Airlines and Lockheed Aircraft Corp. signed a contract last week covering modifications of the carrier's 34 Electra turboprop airplanes, with work to begin in November and Lockheed paying all but a nominal share of the cost.

The modification program, which is expected to end the modification about \$25 million for 34 Electra in airline service, will involve a production line with about 20 stations. Lockheed expects to have reached final agreement with all domestic airlines in about two weeks, then to start contracts with foreign operators after a period of about another month. Modifications are designed to correct wing conditions which apparently led to the Electra crash (AW June 25, p. 89). American's work in the program will be confined to the extent of lowering the aircraft to Boeing and lock and test wing flaps. This is the pattern all the contracts are expected to follow.

Scheduling of American's Electra calls for delivery of six to a test to Burbank with work on the other five to be completed by July 1961. It is understood that Lockheed hopes to remove Federal Aviation Agency certification of the modified aircraft around Dec. 35.

American has not decided whether wing conditions will be removed from each modified airplane as it is returned to service, or whether the modification will encompass the whole fleet in modification.

The modifications consist of the addition of attachments between the engine and its mount, additional attachments between the mount and the aircraft structure, bolting of the wing splices which run out from fuselage behind wing tip, and stiffening of nose attachment ribs in the addition of new loading. The additions are designed to eliminate the coupling of loads transferred to the wing tubes believed to have caused two fatal Electra accidents.



Aft-Fan Type Turboprops Power Soviet Tu-124

All jet-type turboprop engines designed by Soloviev are being used in the Soviets to power the new Tupolev Tu-124 turboprop: 46-seat transport (AW July 4, p. 40). A. A. Arkhangelsky, top assistant to A. N. Tupolev on the Tu-124 project, said the aircraft was powered by two turboprop engines on each of the front pair — does not differ at all from a conventional turboprop. It has the same compressor, combustion chamber and gas turbine. However, while the turboprop engine, the gases, as passing through the main turbine, encounter not neither one—the so-called fan turbine which is not connected mechanically with the main turbine. Arkhangelsky said the first Russian designer to use the true turboprop to develop the new engines. Previously this has been identified as "double core" engines in Soviet engineers in public discussion. General appearance of the Tu-124 is similar to the other transports in this

Tu-104 family, but its landing gear is about one foot shorter than that of the Tu-114, its landing is shorter, and its wing leading edge and engine air duct lips are changed. These wing and duct changes were necessary to permit the engine to be 10% shorter than the earlier Tu-104 and Tu-104A which are powered by pure turboprop engines. Only other apparent change on the new smaller transport is an increase in engine air duct inlet size for the jet engines. Arkhangelsky was recently promoted to the status of general designer and has entered the circle of top Soviet aircraft engineers with Tupolev, Mikoyan and the other designers whose names are most closely identified with the position. Arkhangelsky has been design general designer in Tupolev's organization for some years and placed a major role in the design of the Tu-104 and Tu-114 aircraft.

now the leading Soviet aircraft passenger. First domestic scheduled route service was introduced in the fall of 1948.

In just, only five of the 17 trunk lines reported an increase in scheduled passenger miles and truck gains were relatively small. No carrier failed to report an increase in coach traffic and the gains in most instances were substantial.

The industry, during the last six months, produced a total load factor of 77.15% in first-class traffic on 13.56 billion available seat miles. Coach load factor for the entire industry during the same period was 52.95% on 13.44 billion available seat miles. The success that was achieved in first-class business is attributed to increased seat capacity provided by the return of aircraft fleets. Only four carriers reported a load factor improvement during the month of June. The increase of three of the four carriers' load factor performance—Delta, National and Northwest—is attributed to the reduction of scheduled by Eastern Air Lines because of labor problems (AW June 20, p. 17).

Bozell Airways showed a load factor increase but Northwest's load factor is somewhat curiously the same during the month. Continental's load factor dropped approximately 10 points. The trend during the last six months of the year is an aggregate decrease from an excellent position set by the airline industry in the past. Normally, transiting traffic tends to remain fairly stable in times of general

business recession. During the 1954 business decline, when the annual gross national product dropped 14%, levels marked the previous year, airline traffic continued to expand although the rate of growth was slower than it had been in previous years. In 1958, when the annual gross national product rebounded slightly, airline business rebounded from decline at the rate of an insignificant 0.5% drop from 1957 to 1958. Brief traffic declined substantially that year.

It is the general feeling among a large number of airline executives that airline business should follow a growth pattern even in periods when the general economy suffers in two-pulse, plus, minus. As a result, with business activity somewhat at a high level, industry executives are finding a difficult time to place some reason for the disappointing showing during the last half of 1958.

Turboprop-powered transports are becoming increasingly popular, the accident rate has been cut since the open-

ing months of the year and air travel has been looked this year by the most interested governmental groups ever considered by the industry. On the even side, revenue, employment at a new record in May, passenger income has risen steadily for the past six months and continued load being in 5% above the same period last year.

On the dark side, transportation costs in the nation have dropped for the sixth consecutive month in prices on new and used automobiles, tires and gasoline slide downward. At the same time, the airline industry has moved to take advantage of the Japanese's 45% fare increase granted by the Civil Aeronautics Board. The move has resulted in an effort to better define air travel rates.

Competition is becoming keener as new carriers introduce new turboprop and turboprop transports to compete with older jets which increase available seat miles but reduce load factors.

The industry, produced 24 billion available seat miles during the first six months of 1958 compared with 21.5 billion in the same period last year. Complaints of the quality of service in some areas appear to be growing.

There is serious concern among executives that the business boom will undercut the opening of 1958 has all made last week of its strength. Staff production has fallen from 91% in the first week of March to 82% in the second week in July. Talk about a recession in the stock market has all but subsided.

British Government Will Support VC.10, DH-121, Argosy Programs

By John Tumbell

London—British government will support the Vickers VC-10 and Super VC-10, the Armstrong Whitworth Argosy and the de Havilland DH-121 transport under a new aid program for the aircraft industry, but the extent of support will not be disclosed until both are approved by parliament.

The announcement, which took place in the House of Commons, was made by Aviation Minister Dennis Sandys in the House of Commons.

The full extent of the government financial contribution and contractual arrangements was not to be revealed, Sandys said.

In a roundup of industry reaction to the news, Sandys said, Armstrong Whitworth preferred that government support for these four aircraft will be most substantial, and will be in addition to all previous government contributions by way of orders.

General opinion suggests that main objective of the government intervention is to underwrite the production of all four aircraft since current orders up to the tender-offer number. The figure in the case of the DH-121 is believed to be 100 aircraft, and the total capital contribution by the government spread over the four aircraft is no less than \$2.50 million.

Fund Allocations

The figure would be allocated to the two manufacturing groups in approximately equal shares, with the DH-121 group receiving the larger share of each aircraft.

Armstrong Whitworth, which has sent \$45 million in the Argosy program, expects about \$15 million to be outstanding the 40 aircraft orders in order.

To de Havilland it could mean an extra \$60 million with the rest going to Vickers.

Both the Hawker Siddeley Group and British Aircraft Corp. emphasize that the business contribution is much more a loan than a grant and will be subject to a bank credit review. The government is considered partner in the deal—well after the losses and profits throughout the life of each type.

In the manufacturing, the minister also said that the business boom will undercut the opening of 1958 has all made last week of its strength. Staff production has fallen from 91% in the first week of March to 82% in the second week in July. Talk about a recession in the stock market has all but subsided.

All four approved aircraft have three things in common: a well developed production program, market orders, and

sales in three distinct major transport categories. It appears reasonably apparent that no aircraft which does not satisfy these requirements will be eligible for government aid.

In this context, it is thought significant that neither the Avro 748 nor the Handley Page Herald were named as beneficiaries. Yet both are flying both in an important transport category and both need more orders.

Similar Problem

On the threshold of a similar problem stand BAC's attempts to build a scaled-down version of the VC-10 designated VC11, and this is on Vickers' product with Vickers and Vickers products. Although the size and range details of the two-transport VC11 have not been disclosed by BAC, it is generally believed—partly by a British-to-aircraft company which the British air force of the DH-121, Switzerland VC11 would be powered by four Rolls-Royce RB162s.

Vickers agrees that situation and mentions there is a definite gap for the VC11 (AW Sept. 28, 1959 p. 51).

The company believes that in the face of the current market needs with the aircraft, it will not enough orders to justify the cost to approach the government for aid.

Vickers believes it will obtain government backing for the cashing of £187 million in an RAF replacement order for the Vickers Viscount, post-engineered over from and communications aircraft.

The same is true of the F-37, the new version of the leading BAC product, now sold Armstrong Whitworth. But although the government appears to have indicated its willingness to adopt the basic aircraft, it does not seem to require a special airport for that role which does not also have a commercial sales potential.

Market Survey

On the point, BAC has still to be able on the basis of a market survey now proceeding, whether to go ahead with the F-107 in a Vickers replacement. Decisions on both the VC11 and the F-107 are expected within a matter of months, Armstrong Whitworth believes.

BAC has named the Bristol Siddeley BS77 jet engine as the powerplant for the F-107. The engine is not available in the United States. Only detail designs in the aircraft

systems will be needed to tailor the original Mustang design for engine service.

Sandys also said he is considering an Avro 748 engine which has been designed (AW May 14, p. 47) for the dual role.

Officials at de Havilland were cited by Sandys' statement. "It will make a slight difference to the foreign sales potential of the DH-121," a spokesman told Aviation Week. Besides underwriting the production of aircraft and beyond the order book, it provides an incentive for research, development, tooling and proving costs.

Total Aircraft Sales

De Havilland expects to sell another 10 aircraft to British Overseas Airways and 25 in the next six months, bringing the total DH-121 aircraft sold to British operators about 100 aircraft by 1961.

The company expects to sell more Conquers in the next six months, although no longer expect a large order this year for the Conqueror, one speaks now and, "are expected to sell about 10 Conquers in Middle East and South America within the next six months."

Allegheny Estimates Convoir 540 Costs

Washington—Allegheny Airlines has established 77% as the maximum total operating cost for the Convoir 540, which is powered by Napier Eland turboprop engines, now set at 91.5¢ per revenue plane mile. The report covered the first nine months of 1958, representing approximately 50% of the plane.

Cost per available seat mile was reported at 1.5¢. Allegheny is operating the airplane with a 12-seat configuration. However, and according to most direct operating costs now reported by the airline at 14¢ per hour.

Allegheny, said a straight line depreciation policy, reported at 81¢ an hour on a 248-hour, 12-seat plane. It has been calculated at \$617,300, with a 1958 annual value and 120 month life. Total depreciation costs amounted to 20¢ per seat per revenue mile.

Total direct operating costs for the nine-month period totaled \$145 seats per revenue mile. Included in these were profit salaries at 17.5¢ cents, fuel at 16.6¢, and insurance at 6.9¢ cents. Depreciation amounted to 29.5¢ seats per revenue mile.

Capital Electra

Los Angeles—Lombard Aircraft Corp. is looking for customers for its Electra, now sitting on its line at Burbank, pointed out Capital Airlines executives. Capital had a tentative order contract for the aircraft but Lombard now says that if the airline is unable to take delivery because of its financial condition, "the airline customers are in the picture."

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CAB Inadequacy-of-Service Ruling Upheld

Washington—In a decision that may have far-reaching effects on airline flight scheduling policies, a U. S. Court of Appeals last week upheld the Civil Aeronautics Board's authority to order a carrier to increase flight times when each service is found to be inadequate.

The decision affirmed a CAB order issued in November calling for the addition of two round-trip north flights daily to Capital Airlines between Toledo and Chicago, Philadelphia and New York. The case arose from a complaint filed with the Board against the Capital service by the city government and the Chamber of Commerce of Toledo.

As of late last week it was too early to determine industry reaction to the decision. Conversely, however, the airline industry has held that the freedom of scheduling flights is a management prerogative because of operating efficiency and economic factors involved in a nationwide scheduling program. Capital protested the Board order on grounds that such services were not required and could only be operated at substantial losses to the carrier.

Last month American Airlines filed objection to a Board order calling for the addition of at least one daily flight to the Baltimore-Dallas market (AW June 20, p. 41). In its petition to the Board for reconsideration, American questioned the Board's authority to impose schedules and rates the carrier carried. "Under, long-range implications which threaten itself to wreck the domestic airline system."

In its appeal against the Board order, Capital argued that the Board's ruling would be "unworkable" because it would require the carrier to establish a legal precedent which could affect future rates of greater importance to the industry. For example, a Board decision in the current CAB New York City hearings could bring about an order directing the implementation of a substantial increase in coach services on short and medium haul routes (AW May 14, p. 38).

In the end, there has been strong evidence that the Board is prepared to establish standards which set the amount of coach service which should be offered in certain markets. The airlines maintain there is no feasible measuring rod which can be applied to the scheduling of coach service in all markets under all operating conditions.

It is because of these two widely divergent views that a Board decision making its position could result in a test case that some carriers might be inclined to meet more than higher courts be afraid. During the hearings on this case there were strong indications that Economic Consultant Paul N. Puffer was

debarred to bring about a decision that would call for the introduction of competitive-type services in high density short-haul markets at sharp reduction from other airlines held that such services can not successfully be operated at the present time.

Airline observers have been not accurately reported that the Court of Appeals upheld the Board in its decision in Chicago. Capital Airlines has announced its intention to add one service to the Toledo market or to order the addition of new service. However, they generally had not expected that the court would actually support the Board's decision to order the exact type of service which should be introduced—in this case, coach service.

One solution to the overall problem of inadequate air service in markets of moderate traffic density lies in the transfer of a number of airline routes to local service carriers. Allegiance has already proposed the introduction of non-scheduled low-cost commuter service in the New York-Washington market (AW July 11, p. 47).

Furthermore, the airline has told the Board that it is ready to replace Capital Airlines' service at some points at which Capital is seeking suspension. Earlier this month (AW July 4, p. 44), Capital asked the Board for permission to drop points on its routes which provided local service, and the airline is currently studying the possibility of strengthening its route system. To date one of the other Capital routes to eliminate and one of those which Allegiance wanted to acquire.

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Route Realignment

It has fallen to the Board along with the matter of ownership. Capital President David H. Baker noted that the Board would have the final say in the matter involved in the opportunity of obtaining approval or interpretation while providing local service routes with "no larger than the present."

Allegiance agreed that the program would be of substantial benefit both to Allegiance and the immediate area involved and listed 17 other, all but four of which are now served by both carriers, which it intends to take over.

Here are the Capital routes Allegiance wants:

- Washington/Baltimore to Rochester and Buffalo via Harrisburg/Toronto, Williamsport and New York.
- Buffalo to Pittsburgh via Erie.
- Toledo to eastern cities now served by Allegiance.
- Norfolk/Newport News to New York via Washington, Baltimore and Philadelphia.

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**American's First 720
Prepared for Service**

First American Airlines Boeing 720 inter-continental range jet transport is scheduled to start service July 30 between Cleveland, St. Louis and Los Angeles (AW July 13 p. 52). Company designation is 707-423. The aircraft is powered by four Pratt & Whitney JT3C-1 turbojets, but the T208, of which American has ordered 15, will be fitted with P&W JT3D turbojets (AW June 27, p. 48). The 720 features additional leading edge wing flaps for improved landing and takeoff characteristics (bottom photo) and a 41 ft. 6 in. tail 5 ft. higher than the 707-120 tail. Wing area has been enlarged between mid-chord engine pylons and the fuselage (right), although wing span remains the same. This airplane, one of 25 ordered by American, eventually will be modified to the tri-jet configuration. Carrying 90 passengers (48 first class and 42 main), the 720 will cruise at 655 mph, maximum altitude is 40,800 ft. and maximum range is 5,100 mi. United Air Lines jet the 720 into service first between Chicago, Denver and Los Angeles and Pacific Coast routes.



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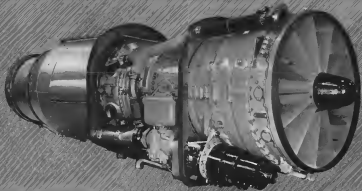
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Airline Traffic—May, 1960

	Revenue Passenger Miles	Revenue Passenger Miles (000)	Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor %
DOMESTIC TRAFFIC								
American	712,711	531,569	69.3	1,333,168	972,232	8,848,661	10,653,972	57.2
Boeing	197,919	159,615	80.7	367,018	172,219	426,321	575,558	66.2
Capital	26,480	137,967	52.4	367,253	376,371	446,618	11,794,136	48.9
Continental	113,246	73,869	65.2	73,163	113,156	341,221	7,662,853	38.9
Delta	197,546	134,156	67.9	419,476	182,221	1,256,277	16,847,588	52.6
Eastern	446,254	345,079	76.3	1,123,107	493,461	1,456,469	35,791,769	66.46
Northwest	126,822	74,724	58.9	264,729	27,161	662,137	9,276,120	47.9
Northwest	117,790	63,120	48.6	119,113	31,812	712,187	4,289,322	47.9
Northwest	136,312	107,466	78.9	472,873	275,668	1,471,584	16,076,166	53.6
Varco West	465,314	372,528	80.2	1,437,477	661,855	3,275,571	57,117,715	58.5
United	456,476	447,620	98.1	8,491,265	976,107	4,172,548	13,539,922	62.7
Western	126,116	49,367	39.9	371,241	64,661	406,433	7,464,521	47.9
INTERNATIONAL								
American	7,819	7,807	99.9	9,129	329	162,717	1,671,938	31.9
Boeing	3,245	13,255	32.9	37,676	139,264	1,266,113	1,483,053	42.9
Capital America	21,243	2,743	12.9	2,293	8,212	9,504,714	54,550,465	41.6
Delta	3,107	3,649	85.9	6,264	20,447	426,724	426,724	66.3
Eastern	61,129	30,516	50.0	126,246	114,819	16,419,688	16,419,688	51.5
Northwest	20,190	1,031	5.1	3,565	181,392	181,392	181,392	41.5
United	1,449	1,543	99.4	9,269	1,479	2,427	176,338	78.5
Western	16,189	36,919	67.4	1,459,216	37,116	609,212	1,605,311	36.7
Alaska	6,467	9,467	68.9	9,269	179,579	721,528	721,528	34.9
Delta America	129,131	175,519	73.0	1,815,493	4,023,481	83,726,468	88,565,442	62.9
Eastern	83,162	152,856	63.0	414,209	9,504,714	54,550,465	64,069,388	46.9
Northwest	34,681	122,422	35.6	1,872,612	2,461,120	16,976,876	19,239,608	41.6
United	9,469	14,373	65.9	61,249	226,620	5,172,371	5,172,371	34.9
Western	11,472	19,122	58.5	1,237,391	3,268,579	79,216	3,268,579	79.3
Varco America	46,437	114,308	24.5	1,159,732	276,076	1,438,911	1,438,911	39.9
United	11,116	36,674	30.3	168,240	1,237,391	14,268,122	14,268,122	47.6
Western	4,262	7,112	53.6	5,684	37,116	760,448	760,448	71.8
LOCAL SERVICE								
Alaska	39,323	11,264	28.6	16,915	26,264	43,214	1,192,326	45.7
Boeing	21,072	3,271	15.5	8,422	8,763	11,269	79,216	39.9
Capital	11,649	2,812	24.1	1,204	2,702	7,763	263,760	36.5
Continental	27,971	9,261	33.3	25,156	9,588	44,297	891,051	40.3
Delta	21,072	3,271	15.5	15,026	15,839	16,155	16,155	66.3
Eastern	11,641	16,212	69.9	16,232	16,234	16,234	16,234	100.0
Northwest	11,472	14,373	65.9	18,415	20,427	42,672	1,438,911	40.8
United	21,072	8,763	41.6	15,839	15,839	16,155	16,155	66.3
United	44,336	16,122	36.4	9,387	9,387	9,387	9,387	100.0
United	41,836	6,519	15.6	15,799	15,799	16,155	16,155	66.3
United	32,642	3,800	11.7	18,211	14,652	14,652	14,652	20.6
United	26,324	6,742	25.6	17,727	17,727	17,727	17,727	100.0
United	24,433	7,796	32.0	8,424	14,123	17,727	17,727	64.91
OVERSEAS TRAFFIC								
Delta	27,679	4,022	14.5	3,217	7,713	891,569	891,569	59.9
Western	19,343	6,642	34.3	64,764	241,079	5,327,753	5,327,753	54.3
CARBO UNIT								
American	1,708	2,452	68.4	58,276	30,247	6,545,108	6,545,108	60.7
Boeing	1,708	2,452	68.4	58,276	30,247	6,545,108	6,545,108	60.7
Continental	1,708	2,452	68.4	58,276	30,247	6,545,108	6,545,108	60.7
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United	1,708	2,452	68.4	58,276	30,247	6,545,108	6,545,108	60.7
Western	1,708	2,452	6					

Latest Olympus version – ready for production produces 20,000-lb thrust dry...



...ANOTHER ENGINEERING ADVANCE BY BRISTOL SIDDELEY

Security restrictions have just been lifted to permit the release of some details of the current Olympus version, the 21, which is now ready for production.

157-in long and with a 45-in intake diameter, the Bristol Siddeley Olympus 21 is Britain's most powerful military aero-engine. It inherits all the outstanding qualities of its forerunners—high power at high altitude, unequalled handling characteristics, low fuel consumption and great operational flexibility. It also possesses the highest thrust/weight ratio of any high-thrust turbojet in the world.

The Olympus series of engines owes its excellent

all-round performance to the two-speed compressor system, pioneered by Bristol Siddeley and since adopted by the leading aero-engine producers in Britain and the USA. Proof of Olympus reliability is given by the fact that it has the longest achieved service life, the lowest specific fuel consumption and the highest thrust of any bomber or fighter engine in squadron service with the RAF.

The enormous development potential of the Olympus has repeatedly been proved. The first production version delivered 11,000-lb thrust dry, the current Olympus 21 has pushed 30,000 lb, and an

even later version is rated at no less than 33,000 lb with reheat.

Olympus applications. The Olympus 21 already gives the Avro Vulcan B 2, speediest of the RAF's V-bomber fleet, an all-round performance unsurpassed by any other strength of its type. The Olympus 21 has been designed to allow the Vulcan to reach its ultimate design potentialities.

The Bristol Siddeley Olympus is ideally suited to operation at transonic speeds and an advanced version has been selected to power the British Aircraft Corporation's TSR 2, a new tactical support/reconnaissance aircraft chosen for the RAF. Other Olympus versions are under active consideration for the next generation of civil airliners—the supersonic transports.



BRISTOL SIDDELEY ENGINES LIMITED

Bristol Aero Industries Limited, 300 International Aviation Building, Montreal 3, Canada. Telephone: UNdercity 9-0471

AIRLINE OBSERVER

► Eastern Air Lines' new program of strict scheduling of flights according to flight demands in place of the former policy of high-rate frequency scheduling has resulted in the withdrawal of 11 passenger aircraft from active service and reduction of the company's personnel force by about 1,000 employees. Program is already increasing load factors.

► Tests of air exports from Douglas Aircraft Co. and Sperry Rand Corp. is starting a test to test airline server people on equipment of the Sperry SP-10 autopilot in the DC-8 jetport transport. Two tests have been reported on individual airplanes in which the results on autopilot control in a slight, continuous roll. Using a line indicator, Sperry found in the use of an KLM Royal Dutch Airlines DC-8 that the loads in the yaw and to the pitch axis accelerations had been reduced. The directional gyro had been changed, and the possibilities existed that pilots may have been deceived. The Douglas-Sperry team is now studying a similar problem in a Panavia DC-8. Federal Aviation Agency is not officially concerned since the autopilot is not a flight-time item and the problem is not considered a hazard. The autopilot is a sophisticated design and there is a possibility some redesign may be undertaken to simplify maintenance.

► Japanese government has approved a five-year expansion program for Japan Air Lines that will involve reorganization of routes into Shanghai and Peking sometime during that period. Plan includes start of service to Europe and around-the-world flights.

► First congressional protest to the Civil Aeronautics Board proposal to eliminate competitive bidding by commercial airlines for military airlift contracts (AW July 11, p. 36) came from Sen. John Specter (D-Ark). Specter, in a letter to CAB Chairman Whitney Gilliland, charged that the proposed change would "make it virtually impossible for small airline carriers to participate in the MATS program of procurement." Also Defense Department is showing an enthusiasm for the program. Deputy Secretary of Defense, James H. Douglas, told Gilliland he was "concerned that, coming at this time, a single revision to the Board's acquisition policy would be made in concert with our efforts to achieve the objectives of" the revised procurement program now being developed by MATS.

► Preliminary warning indicator which can indicate airline weather under plus a modification Black has adapted developed by Radio Corp. of America will start flying the line in a United Air Lines Convair 440 before the end of the month to evaluate its performance in daily operations. Initial experimental tests (AW Apr. 14, p. 52) to date appear encouraging.

► Piedmont Airlines has joined the Airs of Local Transport Airlines to bring local service airline membership to nine. Midweek Airlines recently resigned from the organization.

► KLM-Royal Dutch Airlines is offering a new 15-year \$75 bond issue in the amount of \$13.1 million for the purchase of new aircraft. Bonds, which will be listed on the Amsterdam Stock Exchange, are being offered to the Netherlands at 100% of par through a Dutch underwriting group. No dividend has been made on the type of aircraft to be purchased to supplement KLM's 12 DC-8s and 13 Lockheed Electra on order.

► Railway Express Agency is looking for a new name that will more aptly describe its world wide express services by all modes of transportation.

► Doppler adapts for weather radar, which would enable them to provide ground speed and drift information that now requires use of separate doppler radar, has been developed by Technical Research Group, Inc., Secaucus, N. Y. Originally developed for military use to permit intercept for control radar to also serve as doppler navigation unit, the adapter is expected to weigh about 25 lb. and sell for less than \$30,000. Federal Aviation Agency is reportedly following development. Company says that accuracy of ground speed and drift information obtained would be comparable to that provided by separate doppler navigation radar.

SHORTLINES

► Alitalia, the Italian state airline, reports a \$245,535 net profit in global 1959 operations after taxes and charges of \$6,598,424 in depreciation. In the airline's second report, it was announced 1959 operations ran at a 59% overall average load factor. Rescheduling of public ownership in the airline, which is partially controlled by business giant RSCG (RSCG Industrie 100), the Italian government holding company, was also announced at the annual meeting. More than \$55 million worth of 14.5% 30-year convertible debentures have been issued by the Italian airline.

► Air Transport Association is quick to point out that the Civil Aeronautics Board is producing certain records of the record has been denied by the Board and Air Transport Association has been ordered to produce the records within five days from the date of the order.

► Braniff Airways is offering pilot certificate for air time for an amount in excess of \$10 which a pilot can exchange for an upgrade toward a ticket on any Braniff flight.

► British European Airways has begun construction of its \$10 million passenger terminal in downtown London. The British terminal, located in Cranwell Curve, West Kensington, will contain restaurants, sales and office space for BEA offices now scattered throughout London.

► Flying Tiger Line has received a \$452,000 three-month fixed contract from Military Air Transport Service to operate Lockheed Super H Constellation service from Honolulu to several islands in the Pacific area. Service calls for twice weekly flights from Hawaii to Johnston Island, Kure Island and Wake Island and return and four monthly round-trip flights from Honolulu to Johnston Island direct.

► Inland, the Illinois state airline, has named Canadian Air Services as its general sales agent in North America and northern Latin America. Inland operates routes extending from Europe, through the Near and Middle East and into Asia.

► Federal Aeronautics Board has been recommended for a certificate of public necessity to operate as a supplemental air carrier by a Civil Aeronautics Board examiner. The carrier would have operating rights within the continental United States.

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Ablation Wins Missile Performance Gain

By Michael Yaffe

Significant new advances in materials technology, the result of urgent military demands, are beginning to pay off in the development of missiles with greater speed, payload capability and lower entry cost.

Nike Zos, the Army's antipersonnel missile in its basic missile version, is being completely covered with an ablating fluorocarbon plastic heat shield. New reinforced plastic ablating nose cones are being developed for smaller Army missiles such as the Pershing to increase their aluminum speed and to increase possibilities of detection and intercept.

Titus ICBMs will be equipped with Aero Mark IV ablating re-entry vehicles

which have metal honeycombed reinforced nose cones over metal backup structure. Mark V, the Minuteman re-entry vehicle now under development, will probably be of the same type of construction. New Mark IV and Mark V vehicles will come on in large numbers faster than the original top-of-the-barrier re-entry vehicles first developed for Titus and Atlas.

Larger Warhead

Some Atlas Atlas ICBM squadrons will also be equipped with Mark IV re-entry vehicles. First operational Atlas squadrons, however, will use Mark III re-entry vehicles with ablating reinforced plastic heat shields to carry the nuclear warhead for which they were originally designed. Stronger Mark IV's

will enable them to carry heavier warheads.

Improved Titus II (AWF June 27, p. 31) will have a re-entry vehicle that can carry a still larger nuclear warhead. Fabrication of the vehicle, the Mark VI, is expected to follow the present practice of covering a metal substructure with a molded ablating heat shield of reinforced plastic or reinforced aluminum. Newly developed, uncoated epoxy plastics are also a distinct possibility for the heat shield of the Mark VI and even more likely for the heat shield on the Douglas Skobit re-entry vehicle. The Skobit re-entry vehicle is under development and proposed on the Mark VI as well as on Air Force boosters.

The Navy is postponing extensive development on preheated or oriented graphite structures generally as heat shields for an advanced Polaris (SSBN) re-entry vehicle. But some specialists believe that successful operational graphite nose cones are still some time off, particularly for present and future ICBMs with fast nose re-entry requirements.

Even farther removed from the operational stage is the work actually conducted on investigation making of re-entry vehicles which the Army is sponsoring as part of its study on re-entry probes. The first series to develop an operational ablating re-entry vehicle (for the Jupiter (SRM)) the Army now feels itself more deeply involved than ever in nose cone material problems, particularly as a result of its anti-ICBM work.

Ablating Materials

The Air Force, which for the sake of equities took the blunt nose work approach originally, now has definitely committed itself to the ablating technique for its several defense re-entry vehicles. Through its two principal sub-contractors in this field, West and General Electric, the Air Force will employ a variety of ablating materials on its different re-entry vehicles, including straight plastics, fluorocarbon plastics, metal-reinforced composites and plastic-impregnated composites.

Both General Electric and Aero are constantly developing new ablative materials. Sometimes within the next few weeks, the Air Force will be under re-entry test vehicle in an effort to determine the effectiveness of these novel materials. In the case of General Electric, the results should now appear to be in the direction of pre-plastics, while Aero is favoring the com-

posite metal-reinforced composites and fluorocarbon plastic materials.

In the development of the first ICBM ablating re-entry vehicle, the Mark III, General Electric used a reinforced plastic heat shield over a metal backup structure. The resulting re-entry vehicle proved more than adequate for delivering the payload originally assigned to the Atlas, the company says. It now is being used at Vandenberg AFB, Calif. The Mark III also is slated for use on the three Atlas squadrons to be located at Warren AFB, Wyo., and the first Atlas squadron at Offutt AFB, Neb. There is also a possibility, the company adds, that it will be used on the first Atlas squadrons at Fairchild AFB, Wisc. and Forbes AFB, Kan.

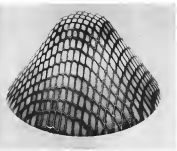
The Mark III, however, is not strong enough to carry the large nuclear warheads which were originally assigned to the Titus and now also demanded by some Atlas squadrons. With Aero's Mark IV re-entry vehicle now to be available for the larger warheads, General Electric feels there is no reason to bring to redesign the Mark III for the Mark IV's job and will probably "top-load" both the Mark IV and Mark V (the Minuteman re-entry vehicle under development at Aero).

Skobit Contract

In addition to its present production contract, General Electric now has the development contract for the Skobit re-entry vehicle. The company also has submitted a proposal for the Titus II Mark VI re-entry vehicle. It is possible with these two projects in mind that GE's Missile and Space Vehicle Department is planning the development of its own epoxy plastic formulations as armor for missile re-entry vehicles. As confirmed GE says it definitely is "going down the ablation trail," although it is also one of the frequent new design work for the nation on magnetron cooling and pyrolytic graphite. Among the efforts involved in pyrolytic graphite work are Rockwell and High Temperature Materials, Inc.

General Electric's new epoxy plastic is called the Glaston system. The latest formulation is in this case a GE 502 fluorocarbon, there are clear, moldable, uncoated plastics and could be used over a metal substructure in a fashion similar to that of the current reinforced plastic heat shields.

These materials have survived test burnings up to 20,000°F for periods up to 10 sec. GE says they are easy to fabricate and less expensive than the reinforced plastics. Like the Aero, General Electric investigated ceramic materials for possible re-entry applications and reported them as satisfactory, the same ceramic the com-



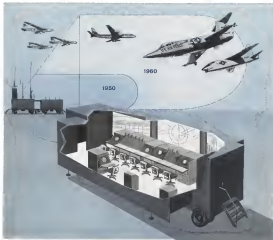
SRM (spacecraft ablating heat shield) of the type that will be bonded to the nose of Atlas Mark IV re-entry vehicle is made from a metal honeycomb-reinforced ceramic that begins to ablate at 10,000°F.



UNDER TEST is a plastic py. reinforced ceramic re-entry structure (shown at top) tested separately due to thermal shock. Reinforced with metal honeycomb, same ceramic used on (shown at bottom) which is probably silicon dioxide, assembly served under the same conditions.



RIGHT, low temperature ablating heat shield, developed by Aero under Air Force contract, is made of Aero's, a fluorocarbon plastic that starts to vaporize at 10,000°. Same material will be used on all sections of Mark IV re-entry vehicle whose underdevelopment is less severe than the nose.



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prone death of information processing occurs technology, fabrication and bonding problems, the aircraft's sensitivity to thermal and mechanical shock, and the difficulty in loading and working large sections into cone structures.

Also, on the other hand, were the same problems but divided that the potential of cones could partly the trouble existed in trying to solve them. Then, in 1959, the company's Research and Advanced Development Division announced the development of Avco's metal honeycomb reinforced cones which it credits as a major breakthrough that made the Mark IV reentry vehicle possible.

Plasma Shields

Now operational Mark IV reentry vehicles are going into production at Avco's licensing plant in Stamford, Conn., will employ ablating Avco's nose cone, bonded to a metal honeycomb structure. Columbus and late sections of the Mark IV, whose reentry heating is less severe, will use reinforced plastic heat shields over the metal substructure.

Mark V, the Minuteman reentry vehicle under development later, probably will follow the same form of cone structure, using essentially the same materials. Shape, material arrangement, thickness and other dimensions of the Minuteman heat shield, however, may differ. Mark VI, its entry vehicle for the improved Titan II, will also probably have the same basic type of reinforced honeycomb heat shield of Avco eventually get the contract.

In the case of the Mark IV, the three different materials used for the heat shield are Avcoite, Avco's and RAD-7. Although Avco claims to use exactly what its materials are, Avcoite is believed to be essentially a silica dioxide bonded ceramic. RAD-7, a plastic organic composite of phenol-formaldehyde resin, silica, and Avcoite, a more conventional reinforced plastic, possibly of the glass fiber-reinforced epoxy type.

At present, Avco is fabricating an entry vehicle of the full scale Mark IV reentry vehicle which are designated Mark IV Mod 1, Mark IV Mod 2, etc., depending upon their desired application. One modification, for example, is made for reentry purposes; another (hypersonic) is designed for operational use and still others, as is the case of the vehicle RVX-1 and 1-1 test vehicles (AVC Inc. & p. 15), will be used for aerodynamic development work as well as testing with different arrangements and thicknesses of the cone heat shield materials.

Composition and arrangement of the operational Mark IV heat shield are now believed to be definitely attributed by Avco and Air Force



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Nozzle Work Aided Ablation Research

Blowing re-entry vehicle design duties in large measure from the work carried out in the aft end of the missile, the rocket nozzle.

By September, 1956, Ames had the first ablating re-entry test vehicle to be designed for a U. S. missile nozzle. Ames became involved in the coordination of ablative materials for this program as the result of the work it was doing in nozzles for rocket nozzles. (This is still an important program as far as the Ames is concerned in that improvements constantly are being made in the ablative, reinforced plastics that line nozzles every Ames nozzle.)

From theoretical studies and laboratory tests, Ames decided in mid-1956 that ablation could handle the job on the Pyrotec ELM re-entry vehicle and also on the X-15M re-entry vehicle, despite the fact that the latter would result in approximately twice the velocity of the former and hence approximately four times as much kinetic energy to dissipate. Consequently, at the time, Ames recommended the ablation approach to the Air Force.

The firing of the first ablating re-entry test vehicle enabled Ames scientists to correlate theoretical and laboratory results with actual flight data. By mid-1957, Ames had fired enough test vehicles to be convinced that ablation was the proper technique for both ELM and X-15M re-entry vehicles. In May, 1956, Ames fired the first full-scale liquid re-entry vehicle and later that year delivered the first liquid-fueled jet re-entry vehicle.

Chemists was one of the first contracts the Ames Ballistic Missile Agency and its contractors, contracted (AM-32, 1956, p. 52). Fabrication and structural problems led them to the use of plastic binders for building the various nozzles. They then decided that the plastic offered better physical and mechanical properties than the resins. With continuing efforts and development of a suitable structural shape, the Ames found that the plastic met successful test results. Ames now has definitely met nozzles made in form of reinforced plastics.

Believing that it would take too long to overcome all the obstacles in the development of ablating re-entry vehicles, the Air Force for the sake of expediency, contracted itself to the test suit approach. In 1956, General Electric and Ames were well along in the development of test suit re-entry vehicles for the X-15 and X-15M. These vehicles consisted of a short test and laboratory from a preformed nozzle support shell and a conical ablator, which on the X-15M vehicle was to be machined from boron.

General Electric had begun to deliver operational Mach 10 test suit vehicles for the X-15 and X-15M and Ames had several in X-15M re-entry vehicle program in later development in standard in production vehicles. In August, 1956, the Air Force decided these proposals to produce ablating re-entry vehicles. Both companies had been doing pure Air Force-sponsored research on ablation and as a result, the first General Electric ablating X-15 (X-15V-1) and X-15V-2 were re-entry test vehicles for the Mach 10 and X-15V-3 and X-15V-4, for the Mach 10, was launched in January, 1959. Ames delivered the test X-15V-1 in May 1959.

General Electric's production of the operational test suit re-entry vehicles, Mach 10 and X-15, could only be seen. These vehicles are in operation with low RAE. This approach is England and in some degree at Vandenberg AFB. Some of the test Mach 10s in fact are now starting to come back to GE's Burlington, Vt., plant for inspection and overhaul.

Although other group will give details, No. 10, it appears certain that Ames will be used over the world war backup structure when the one extreme testing is the greatest, with RAD 15 and Ames going over the re-entry and the re-entry.

As said on the Mach 10 test suit, Ames' contract consists of a metal structure in which the several small, diamond and rectangular-shaped pockets formed from the boron-based are filled with ceramic. Due to particular ablation requirements, each ceramic pocket on the rounded nose has perimeters in the outer surface. At approximately 1000°F, the ceramic starts to soften and, during re-entry, flows back to about three quarters the length

of the reinforced section dissipating about 50% of the aerodynamic heat on the nozzle.

The remaining seven test will be dissipated by the ablation of the Ames and RAD 15 coatings. Ames' Ames and RAD 15 actually represent three different families of re-entry, and Ames scientists are continuing to develop and refine Ames-based and fabricating techniques within all three groups. In Washington, Ames for example, Ames' Research and Advanced Development Division under contract from the Air Force, recently made a large blast testing of Ames for con-

solidation as a possible test shield for the re-entry, during re-entry, several re-entry vehicles which would have been

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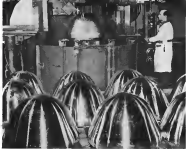
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MAGNESIUM heating structure for Aero Mark IV security vehicle is being contained.



AVCO technicians continue grinding the Mark IV cylinder engine heat shield (above). Another one (top below) is mounted in handling fixture for inspection.



severe heating problems. This throw-away Avco's, Avco now, does not melt or char but partially vaporizes at 2100° and then reappears best.

Good as plastics such as Avco are for protecting reusable type aircraft vehicles under conditions of prolonged intense fire and attack low heat losses, Avco felt they would be inadequate for the severe heat fluxes, turbulence and heat fires that the company expected to encounter in its new ablative type ballistic re-entry vehicles.

High Temperature Ceramics

Basic theoretical studies and experimental work, Avco scientists conducted at the High Temperature Research Center in Warren, Michigan, silicon, silica and boron was the best suited to the job now at hand.

In addition to the low thermal conductivities of the plastics, the ceramics allowed higher levels of decomposition and vaporization.

Unlike plastics, however, the ceramics could bear your thermal and mechanical shock, resistance and, consequently, might needs, break in handling or spoil in flight. The brittleness of the ceramics also gave rise to serious design and fabrication problems.

The fabrication of a monolithic ceramic re-entry structure, although desirable in some ways, was ruled out owing to the great weight and thickness of material that would be required.

On the other hand, Avco scientists reasoned that the fibrous ceramic could be processed and fabricated and spooling (bonded) if the ceramic re-entry structure were built in small pieces in a tube design.

Composite Structures

The small construction of the tube tube, however, created problems in bonding and fabrication. These factors led Avco to the study of various composite ceramic structures using metal reinforcement in the form of wire, impregnation, and honeycombs. The honeycomb proved the most successful in improving thermal shock resistance and mechanical design properties of the ceramic. Moreover, Avco saw the fabricating process in which a standard metallic honeycomb is filled with a ceramic in both chemically feasible and costwise. Starting with the fabrication of small flat plates, technicians graduated in time to curved panels, nozzles and cones. In the process, they developed methods of bonding and fitting.

Theoretically Avco's would lead itself to a number of ceramic fabrication processes. Avco will not divulge which of the processes it is actually using. But various fabrication characteristics,



SPECIAL tooling are used to grind Titan nose. Grinding area fully contains front edge to center line of drive.



particularly the high decomposition of the material—up to 90% of size density, strength, suggest the use of hot pressing rather than the more common techniques such as slip casting.

In rapid fabrication, a technique recently developed by Marquardt's Samuel Sklarow under Air Force sponsorship for making reinforced ceramics could prove of interest. In this process, flexible metal strips impregnated in the form of a wire mesh are forced around a form longitudinally, heated, tilted, or even in a spiral. The ceramic in the corners of stiff dough, is twisted over the strips, flattened and dried. Although the process was slow,



METAL backup structure for flat section is supported (above). Two parts of cylinder surface are noted (below left). None of the other XV-5 vehicle is shown at the lower right.

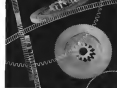


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Looking like a long bullet with a short dart attached to its aft end, the new Mark IV reactor vehicle consists of and is fabricated in three separate sections: nose, radiator and fuel. The nose starts out in a closed die forging of the metal backup structure, which is purchased in Locomex.

In the plant at Stratford, the nose backup structure is turned, drilled, bored and tapped. Hydrocarbons for the Acoside nose nose heat shield are brought together in another part of the plant and played in a die where the nose shield is formed.

After the Acoside shield is counter-matched, it is placed over the metal backup structure and fastened into place. Core structure or components is a controlled temperature/humidity chamber before being and after being. The core is further machined and then sent to the plant assembly area.

Cylinder Construction

Essentially, the same procedure is followed in making the cylindrical section. The cylinder heavily starts out in two left forgings to simplify fabrication. These are later bolted together to form the metal backup structure. Materials used in the fabrication and heat shield are different from those used in the core section.

Backup structure for the base section is the same metal as that used in the nose but is purchased in sheet form. As to both the sheet to shape, rivets the ends together, and adds metal stiffeners.

From here the base cost follows essentially the steps of the other two sections to the assembly area where the three sections are mated after they have gone through a series of inspection and have the necessary components added. From Locomex's Stratford plant, the finished Mark IV reactor vehicles are sent to the designed airport or loaded to Warton Field and then shipped to their destinations, where additional components or, in the case of the operational vehicles, the nuclear warhead are added. Finally, the reactor vehicles at least those destined for flight use are mated to their Atlas or Titan canisters.

The reactor vehicle is attached to the top stage of the carrier rocket by means of conventional lugs. The loading and unloading mechanisms in located on the small end of a cone which is inserted large end first into the base section of the reactor vehicle and attached to the base's metal backup structure.

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AERONAUTICAL ENGINEERING



CONVAIR, powered by Allison 191 D17 turboprops with AeroProducts 608 propellers was modified by Packard Engineering Corp. Vertical lift height has been increased by 11 in. and the horizontal stabilizer has a 40% water span than the standard Convair 440.

Aviation Week Pilot Report:

Allison Convair Retains Good Air Traits

By William S. Reed

Steve Moses, CofE—Recently we tested Allison turboprop Convair 440s retained all the handling, being characteristic of the original Convair 440s and no more than has happened again since of the general purpose aircraft. In Air Force War, flight evaluation showed handling qualities of the turboprop Convair 440s, the same as the original which carried the "pilot's airplane"

label for the Convair 440s. The extreme modifications to the aircraft necessary to convert it to the higher horsepower engine have retained performance without decrease in stability or control.

The original Convair 440s were first built manually, control forces coupled with ample stability and ease of the unexpected failure which were the design of pilots. Packard Engineering Corp. has turned out an aircraft which

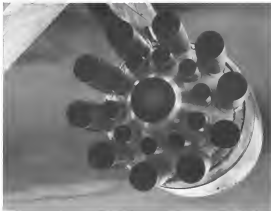
has almost firing traits and also proves an unusually good single-engine performance.

The particular aircraft for this flight was N5121, eighth in a series of a modified aircraft for which Allison Division of General Motors Corp. functions as prime contractor, in turn subcontracting to Packard for airframe work, engine and equipment installation, and aircraft loading (AVI Feb. 25, p. 71).

Most pleasing feature of the conversion



ALLISON turboprop-powered Convair demonstrated very good single-engine performance during Aviation Week pilot evaluation.



Boeing 707 standard engine

The oil that's safe through 500 degrees F: **HOW ESSO DOES IT!**

Jet age aircraft make unprecedented demands on lubricants. Not even the most highly refined mineral oils are able to cope with the temperature extremes in turbine engines. Needed was a synthetic oil with

good intensity and stability at very high temperatures—and easy-flowing properties at very low temperatures. Esso was the first successfully to develop such an oil.



At an altitude of 40,000 ft., temperatures near the engine can be as low as -60°F. But in some of the heavily loaded bearings, with rpm up to 14,000, they may rise to 300°F.



Esso turbine engine oils were ready before the first jet-engine Turbomeca civil/commercial service. Two American Turbo-De 25 and 15 were the first approved oils for all turbine-powered engines. In fact, the development of these engines depended upon the availability of these American Turbo-De 25

also is the increase in performance coming from the installation of 30-hp 901-D13 engines having turbo-propellers 680 propellers, particularly in climb and single-engine performance. Most pilots generally agree that an aircraft cannot have too much power, especially when increased power usually means that someone in the cockpit department will put in a few more units in an effort to make a profit. In this case, however, even though the maximum climbable gear weight has been increased from 15,000 to 15,500 lb., sufficient power will remain to safely conduct single-engine go-arounds from maximum altitude with the aircraft in landing configuration.

Aircraft Modifications

Installation of the turbo-prop engines results in 50% increase in available horsepower while the lower weight of the aircraft means virtually the same load from the legs and propellers and slightly different engine exhaust exhaust after changes are not immediately apparent. Without seeing the Allison Constant speed engine out of the conventional Comanche, it is not immediately noticeable to the observer that the vertical fin is increased in height to 12 in. and the horizontal stabilizer has a 4-in. greater span. Little fan and motor are visible. The constant speed control during single engine operation with the increased power available. A third change was added to the fan motor hinge point to constant fan. Added horizontal stabilizer and elevator area provides new longitudinal control to overcome the destabilizing effect of increased power.

Distinctive Noise

A distinctive sensation is provided in the constant noise level of the engine. This is not to say that the aircraft noise level is higher than that of a standard Comanche. The noise is low. But the engine is more noticeable through the fuselage, engine exhaust and landing, as is a constant 15,000 rpm. All power changes being absorbed in the aircraft's self-controlled, independently actuated propellers.

The only change in noise level is created by the increasing and decreasing acceleration noise, and this is not really apparent. Landing descent, and especially in the landing pattern, the variation in engine noise experienced in both jet and reciprocating engine aircraft does not occur.

Starting procedure is greatly simplified and that is a conventional Comanche. A general turbine compressor, started by the aircraft's internal power is rotated by a guarded switch which is put into the run position after which a starter switch is successfully de-

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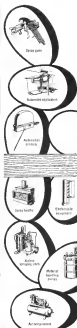
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5. TGO-qualifier tank trailers for long distance hauling of liquid hydrogen

The conquest of space is demanding vital assistance from that young giant of applied sciences, cryogenics. To this end, Air Products has put cryogenics to work in producing the large quantities of liquid oxygen and liquid hydrogen required for U. S. rocket programs.

But producing space-age liquids and gases is only the beginning. The space age requires specialized "hardware" to use them effectively . . . specialized systems to handle them, store them, pipe them and transport them . . . specialized research skills to develop and design equipment and plants of even greater capability . . . specialized fabricating techniques to translate those designs into reality . . . specialized construction engineering abilities to erect new plants with assurance . . . and specialized operating know-how to keep them efficiently on-air.

Air Products meets these challenges with an unparalleled range and depth of capability that accounts for much of the nation's military cryogenic capacity. As the pioneer and leader in applied cryogenics, Air Products today is as closely linked with U. S. missile and space programs as its cryogenics itself. We are ready to provide data and recommendations on applications of interest to you. Air Products, Incorporated, Allentown, Pa.

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DEFENSE and SPACE DIVISION



'Inside Man' in the search for subs
Jack Welch earned the submarine's Gold Dolphins insignia while serving aboard Navy subs as a Chance Vought missile engineer. Now, MIT-trained Welch is an anti-submarine. His intense knowledge of sub operation is characteristic of the Anti-Submarine Warfare Department of Vought's Alexandria Division. Today—with missile subs threatening us—Welch and his veteran colleagues are working hand in hand with Vought's Electronics Division and Vought's Research Center on improved underwater detection systems that can find and destroy the hidden enemy. In addition to ASW systems, Vought Aerospace develops missiles, aircraft and other products for defense.

CHANCE VOUGHT   **AERONAUTICS DIVISION** DALLAS, TEXAS

pressed. A green light goes on when the compressor reaches operating speed.

Engine start is accomplished by putting the bleed air selector switch in the *start* position, moving the fuel and gas valves nearby to the *on* position and depressing the starter button. The on-gas pressure is depressed momentarily to provide an enriched mixture for ignition.

Once one engine is brought up to speed, the other can be started from the ground compressor or from bleed air supplied in the powerplant, which at this time is running.

Port and starboard are made an engine supplied by the on-gas engine drive the double pump and the two electrically driven fuel-injection pumps, one *a/c* and one *d/c*. Electrical status checks are made on the engine-drive gear train, its two 40 kw alternators and the shaftline motor.

Recent tests on the engine room are now made the ground air guide (18,000 rpm) usually, resulting in considerable noise reduction during this phase of operation. A bottom of the top of the counter potential-mounted motor drive panel is allowed to be set on engine into ground rails. The switches return to position automatically when the power control lever is advanced.

Now mixed running, controlled by a switch at the pilot's left, is used for control during *loving* and *start-up* approx. 6075 lb is used, and 1000 lb is used on the standard engine.

Lengthy tests provide a successful with power engine on, set control to check out the engine. Subsequently, checks on another power are made before or during this, during only a check of the fueling system and the full power can go up to be accomplished. The power check, revealed that the nuclear inlet temperature for 970C and the engine was producing 3 510 hp, less than the 3,450 hp, which would have been produced on a center, stand and day.

Takoff Performance

Takeoff is accomplished in the same manner as the conventional aircraft with the exception that the Allison Course Acceleration Factor, making the suggestion of events occur more rapidly. The aircraft is rotated smoothly and a safety stop check-out technique is utilized to prevent the stepped down building up on rapidly below the gear falls to touch.

Refueling loaded up the main gas firing down using the gas relief tank line speed from 120 to 120 lb then so, 110 lb, will be executed if a maximum stop check-out technique is not used.

A thrust-reverser signal system is set to automatically feather the propeller if power output to the prop falls below

390 lb thrust. Auto feathering is accomplished rapidly enough that drag from the dead engine does not impact on takeoff performance.

But late at dusk the aircraft at maximum gross weight, low level, stand and in 115 lb and then the speed rapidly reached. However, the climb angle at this speed is so steep that over the nose visibility is somewhat compromised. Generally, a nose attitude angle results from using about 100 lb.

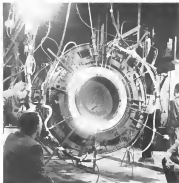
After climb speed is reached, power is reduced to 89% nuclear inlet temperature which produces 3,500 hp. Not included in the horsepower indicated by the torque gauges is up to 720 lb thrust produced by the exhaust.

N121 which required 49,500 lb at takeoff, was climbing 900 rpm after approaching 20,000 ft, more on load with the turbine inlet temperature at 870C and 1,600 hp being delivered to the prop. It increases, the mixer duct could have been conducted at maximum maximum power with a turbine inlet temperature of 98C per

doing 3,600 hp under standard conditions. Scaling tests of the converted Canavie remain unchanged by any of the differences in external configuration due to the conversion. The aircraft consumed a gross, 100 lb at 55 lb with gas and 70 lb of Regs down. At this point, the control valve was about fully back, and the ship's way a stall could be induced was to allow the valve gradually to go forward and then return it rapidly to full aft. Using this technique, a full stall was produced at 75 lb. 100 lb. Recovery was effected with the release of the control valve to the neutral position.

Negative Torque

Check of the negative torque, using signal was made at 20,000 ft, by decreasing all fuel to number one engine. The NTS signal is not to operate if the wet areas between 210 and 270 regular horsepower each is happens when the engine inlet fuel is removed. When the propeller starts to slow, the engine over-revives, the NTS over



First Photo of GE J93 Burner

Combustion system of the General Electric J93 Mach 3 supersonic engine (shown) is tested above sea level. It offers several advantages as well as maintenance checks on its performance. It is applied to the combustor with the same temperature, flow rate and velocity experienced over its flight envelope as that of operating conditions except, absolute pressure level is over. This is fed to the combustor and the compressed inlet air temperature is checked. Combustion efficiency is measured by taking gas samples. Pressure measurements determine combustion pressure loss. Thermocouples are used to monitor the engine at temperatures around the combustion chamber.



Russians Build Modified Mi-1 Helicopter

First photo of a modified Mi-1 helicopter, shown with Aeroflot markings indicating little external configuration change. The new version has different rotor blades, hydraulic controls and a new standard cabin. Forward is 161 in., cruising speed 85-95 mph, range at cruising speed 510 mi and ceiling 10,000 ft. Engine exhaust behind door is changed from radial Mi-1 and the belly and tail boom bearings, possibly for increased air efficiency. Also for the change was reported as the result of a

visit of Vladimir Kharukhin during a tour to the Kremlin from Yuzovka Airport last November as to Mi-1 that, besides the 5-12 passenger helicopter, a small, transport helicopter. "Like the Mi-1, the new model was modified. Hence the name Mi-1bis (Mi-1 plus one) for the modified Mi-1, which will be used as an aerial taxi. The helicopter will be equipped for night and all-weather operation as well as for water landings (AW July 4, p. 16).

"corrected" the prop pitch to suit the drag. A winging then occurs in the prop pitch gear's operation warning the pilot by a light warning system that the feathering procedure should be initiated.

Very little drag is produced by the winging. During the flight, the left prop was feathered and 20,000 ft. was reached without advancing power on the other engine above normal cruise. With only one engine operating and the other feathered, airspeed stabilized at 115 kt. Minimum control speed at maximum gross weight is 56 kt.

The aircraft exhibits very good stability characteristics during its approach using the automatic landing system. Sufficient fuel had been used by the time to bring the gross weight down to before 45,000 lb., and the recommended approach speed was 128 kt. Rate of descent at 120 ft/min. was established by setting the turbine inlet temperature at 1500C, yielding 500 hp per engine, and with gear and approach dips of 271 deg. The Allison C-series could down the glide path at a stroke 128 kt.

Go-around is quite spectacular with

the power allowed by the Allison turboprops. Although not attempted on this particular flight, single engine go-arounds at maximum gross landing weight of 50,000 lb. have been accomplished repeatedly during certification without the most trouble associated with such conversions, according to Panavia test pilot Jan Bevel.

Landing, the Allison C-series is accomplished with the same ease as its jet-powered predecessor. Final approach of 110-120 kt. is gradually slowed to the idle over the flare speed of 56 kt., from which a slight nose high touchdown is recorded. Here again, the critical spot, at the engine is disengaging in a new pilot. Judging by the sound of the engine the aircraft should have passed altitude rather than setting on the runway when the flare-out started.

Reverse Thrust

Full reverse thrust, approximately 75% power, can be applied as soon as the nose wheel touches the runway, which is generally almost immediately after touchdown. The converted C-series, because of the added director

tailer, is somewhat easier to flare than the standard C-series, but is not as smooth as which the nose wheel can be held off for very long. As usual the control stick is held firmly forward by the operator during thrust reversal because of Allison fuel.

Users of the Allison C-series were in the field report that they are performing well and have raised up no problems. Two reports of trouble have appeared and also one that the aircraft have become involved in accidents with passengers and pilots alike. One operator reports that transition requires about 5 hr for pilots with previous C-series time and about 12 hr for those without it. The unconverted operator requires a complete Airline Transport Rating check as part of transition training.

Although the Allison C-series are now in service, the main reason to be considered the sublight turboprops and the anti-icing system. Instructions now is installed in the number one aircraft to gather data on the bleed air wing and tail section system, and to establish gun settings for the aircraft.

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In his case, ACS engineers work directly with the company personnel to select installation sites and determine optimum assembly methods, sequences and test procedures. Then the whole assembly sequence is photographed including the steps of tools and equipment and the specialized techniques of the engineer and experienced assemblers. Step by step visual instructions are taped and synchronized with the slides. In this way the production know-how of the most skilled personnel is permanently recorded and made available for all work stations.

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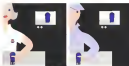
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AVIONICS



NEW ASR-4 RADAR now in final test at Newark Airport, a host of improved avionics capabilities scheduled for installation in 35 months by Federal Aviation Agency. Display console shown in Newark Instrument Flight Radar room, large 16-in. diameter cathode ray tube. Clueless shows receiver and navigation software supported by electronic mapping techniques. Pattern shows range with moving target indication according to black out field targets at distance of 12 mi. (between second and third range scale), with current radar beyond that point. New ASR-4 radar was designed and produced by Tecon Instruments Inc., Appleton Division.

ASR-4 Airport Radar in Final Test Phase

Newark, N. J.—First of the Federal Aviation Agency's new ASR-4 airport surveillance radars, an improved design slated for installation at 35 airports in 1975, is now undergoing final system tests and should become operational here this summer at Newark Airport.

Designed and built by Tecon Instruments' Appleton Division, the ASR-4 represents the company's first entry into ground-based radar systems and its initial venture into the surveillance radar field. In addition to the 510-ft radius ASR-4 radars, Tecon Instruments will supply FAA with 50 medium-range radars for other ASR-2 and ASR-3 airport radars under a \$1.4 million contract, which will give three orders some of the new features of the ASR-4.

Major Improvements

First in a series of range improvements which the ASR-4 claims over its predecessors.

• **Improved coverage:** The ASR-4 is designed to handle aircraft at altitudes up to 27,500 ft and ranges of 60 mi. Original specifications for the ASR-3 called for coverage to 10,000 ft and 30 mi, but radar performance shortcomings were corrected to about 23,000 ft and 46 mi range.

• **Improved Moving Target Indicator:** Use of improved pulse sequence and electronically steered radar's "blind spot" which caused loss of target in previous radars when aircraft had a

radial velocity of about 120 ft relative to radar antenna. ASR-4's Modulated radial velocity screen at about 1,700 ft, making it possible to see aircraft at speeds up to Mach 3. The MTI provides double cancellation of radar targets, instead of single cancellation used in previous ASR radars.

• **Interference Rejection:** The ASR-4 incorporates a number of programs for measuring interference from other 5-band radars operating in the vicinity.

• **Circular Polarization:** Antenna incorporates provision for circular polarization, as well as some conventional

vertical polarization, to reduce clutter during heavy rainfall. ASR-4 originally did not have circular polarization but it has subsequently been modified to incorporate this feature.

• **Signal Enhancer:** The ASR-4 incorporates a video integrator which provides signal enhancement, with up to 138 db of integration for weak signals at longer ranges. System can be operated with auto integrated 3-11 video not to any range selected by the controller and with integrated video



ASR-4 radar antenna at Newark airport structure which houses instrumentation, receivers and performance-enhancing equipment. Radar has 60-mi. range at 27,500 ft altitude.



Raytheon activates industry's first center for Anti-Submarine Warfare, Portsmouth, R. I.

Now functioning, Raytheon Submarine Signal Operations' new ASW Center designs, develops and produces complete systems for detection-through destruction of objects in *Hydrophone* (ocean depths and interface). Sub-systems embrace: torpedo guidance and location devices; sonar and mine countermeasures; communications, IFF, oceanographic equipments.

Among unique Center facilities are: 180,000 gallon "L"-shaped acoustic tank; Also, fully-equipped 65 ft. mobile sonar test boat; acoustic pressure tank up to 6000 psi.

Current programs provide for 3D anti or highly directional submarine, air, and ship-borne sonars; trainers; listening and measuring devices. Past advances effected by this Raytheon capability include: first fully hull-integrated comprehensive detection system — for Navy's nuclear-powered hunter-killer submarines; transistorized deep-dip airborne sonar; first helicopter-borne echo ranger; non-interfering sonar trainers. We believe location, facilities, and capability make this the nation's primary industrial center for ASW research, advance development, engineering, and production.

For Raytheon ASW Capabilities Brochure, Write: Director of Marketing, Equipment Division, Dept. B2, Raytheon Company, West Newton, Mass.

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beyond the range which is selected.
• **Automatic Performance Monitoring.** Performance of the ASR-4 is continuously measured in terms of key parameters such as power output, voltage standing wave ratio of waveguide and antenna, transmitter frequency and return wave figure, such automatic warning lights in tandem to the operator whenever a critical parameter falls below prescribed standards.

Radar Displays

The ASR-4 installation at Newack provides two plan position indicators (PPI), *one operational and one for maintenance*, each consisting of a 16-in. diameter cathode ray tube with a P-7 phosphor screen, one-third larger than previous scopes. Number of PPIs used at any installation depends upon the operational requirements.

Each PPI console employs separate motor controls which enable the operator to select desired range, MHz, vertical gate length, and any one of three modes of video presentation: internal radar video only, moving target indication only, or a combination of both.

Navigation, heading aids and azimuth paths are superimposed on the display by electronic means, which characterizes the plane operator used in the ASR-2 and ASR-1. The electronic ranging processor automatically changes the scale factor of the navigation/heading aids display when the range of the scope is changed. *Visual Interference* has been greatly reduced by 14° beam per inch, which reduces the risk of the ranging beam to about 6 in. on the in-track range scale.

The ASR-4 incorporates an electronic strike and search which enable the controller to quickly determine the distance and bearing to any aircraft on the scope. A small *penetration* on the right corner of the console is used to position a small unattended spot on the target, after which aircraft target is indicated on a counter. *Position* also is used to position electronic cursor to aircraft target, which causes its bearing to be indicated on another counter. Counter again can be set to determine target bearing relative to radar antenna or to any other point.

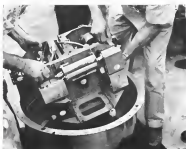
Growing number of civil and military surveillance radars has raised problems of mutual interference with other ASR radars, which prompted the present design effort to reduce interference. Possibilities included in the ASR-4 include a filter which reduces spurious signals, and a three-way receiver filter, tunable from 2,700 to 2,900 mc., which limits receiver bandwidth to 16 mc. at the 7 db down point.

The ASR-4, like the ASR-2 and



Discoverer XII Was to Analyze Recovery Sequence

Unmanned Discoverer XII which launched last month (AW, July 4, p. 59) carried a number which and sensors capable of monitoring the crash landing, in recovery, including sequences from Agena, telemetry, and other data and provide deployment. Object was to detect areas for failure of attempted recovery. The photo shows representation in schematic case. Bottom photo shows remote instrumentation being inserted in capsule at Lockheed-Martin and Space Division.





TWO STRIKES ON THE OPPOSITION

When SAC's B-42 crew steps up to the mound it can throw two deceptive curve balls before striking up to deliver the third strike. Two GAN-17 intercept missiles slash beneath the wings of the B-42 intercontinental bomber can quash enemy defense centers and clear a path to the main target.

Blazing into action at supersonic speeds, these GAN-17's can be used either as autonomous guns or as the main objective itself. Initially guided, they can fire enemy radar by making passes at pseudo-targets before heading for the actual one. To further confuse the opposition, the jet-powered missiles can fly high or low as the way to the strike zone.

The GAN-17 intercept missile was designed and is in production for SAC by the Missile Division of North American Aviation.

**THE MISSILE DIVISION OF
NORTH AMERICAN AVIATION, INC.**



Company Citation

ASK 3, it has duplicate except for the antenna to provide complete standby capability in event of failure. Each channel of the ASK 3 has built-in automatic performance monitoring provisions, as well as means for detecting over and under-voltage conditions of modulator in one channel and under-voltage in one channel. If one of these faults should occur, modulator and driver voltages are removed for five seconds to allow built-in short after which voltage is again applied. If the antenna is cycled three times without clearing the fault it locks out with voltage removal and signals operators at the FM console and at the transmitter site to switch over to the standby antenna.

Surge protection is provided in event that cooling air flow to the wave antenna is interrupted; surge protection exceeds safe limits as there is less air supply for the modulator high-voltage supply at transmitter, except that the system locks out without recording.

The 175 ft. wide rotating antenna, built by General Electronics Division of the Clubco Co. is designed to operate without redeploy provisions. It provides a 11 deg. strike beam in azimuth and a constant squared shaped beam in elevation. Antenna rotates at 15 rpm. Selection of vertical or circular polar antenna can be made by remote control from operator's console. Antenna gain is 14 db with first nulls down at least 20 db, according to Texas Instruments. Reflector also supports a 26 ft. long radar beacon antenna.

The dual transmitter, each rated 0.1 megawatts peak power, dual receivers and automatic performance monitoring equipment are housed in a structure adjacent the antenna at Newark Airport.

Being cracked the highly complex two civil ground radar ECM, Texas Instruments management hopes to develop considerable future business in the field, both in new equipment and in updating existing systems. Company's Aerospace Division has placed the biggest market with the sale of a radar modification lot to Belgium.

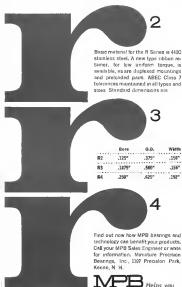
FAA Unveils Fremont En Route ATC Center

FAA has awarded its multimillion dollar air traffic control center at Fremont, Calif., which will ensure complete control over all military and civilian IFR flights in its territory over the entire San Francisco Coast, in assuming control responsibility from the present Oakland facility. It will be the first of 15 such high-automation and automated facilities in the nation. Similar centers at Cleveland, Atlanta

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SPECIAL DELIVERY PACKAGE

Portable air traffic control towers—to be produced by Hamilton Standard—can be flown or trucked to speed mobilization of remote TAC air fields

The Air Force has selected Hamilton Standard to produce 150 air traffic control vans, plus 53 trailer-mounted electronic shops for servicing the control vans and other types of electronic equipment in the field. The vans will be used, as shown here, by the Tactical Air Command to direct air traffic at remote or temporary landing fields.

LIGHTWEIGHT, RUGGED, EASY-TO-OPERATE—Each van weighs about a ton, measures 9' x 5', yet houses an operator, transmitters, receivers, and most of the basic weather equipment of large airport control towers. The units are built to withstand the most grueling environmental conditions—cold, wind, dust, ice, humidity, altitude. Every construction element—equipment, lighting, sound conditioning—is engineered to blend into and equipment into an efficient operating unit.

OTHER GROUND SUPPORT EQUIPMENT IN PRODUCTION at Hamilton Standard includes liquid cooling units for an advanced airborne missile system, cooling packages for a missile site application, and electronic modulators for military cargo aircraft.

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ENGINE CONTROLS for over 20,000 aircraft gas turbines have been produced by Hamilton Standard. The company controls control and various engine control systems.



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Conventional solar will also be used in conjunction with the telecomputing system, with the majority of the system located at Scupper Park, on the San Mateo hills. Riders will be escorted to the Center from there and from other sites at Pinnacles, Red Bluff and Sacramento.



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PROBLEMATICAL RECREATIONS 23



Assume that every tree has at least one leaf. If there are more trees than there are leaves on any one tree, then there exist at least two trees with the same number of leaves. Is the conclusion valid?

— *Extremal Structures of Nonsymmetric*

Logic prompted us to acquire *Serronodendron* (Celastraceae) led, whose main plant is in the Restio area of Tueros. Our specimens there will be closely linked with our production of natural guidance systems for the Lockheed CP-140 fighter-bomber at the Royal Canadian Air Force

ANSWERS TO LAST WEEK'S PROBLEMS There's no closed-form solution, but Mathcad will get you 8987.

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A 1987 flame taken test indicates the possible use of a new class of GFR in new Class 80-100 materials. The same technique of solidified steel is planned in less than forty seconds.

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MISSILE TRAJECTORY MEASUREMENT SYSTEM (Mitsun) will be built for Atlantic Missile Range by General Electric's Defense Systems Department. Model above shows fire stations in the system, but covers in L-shape with 10,000 ft. and 100,000 ft. spacing between stations in each leg. Range will provide coverage out to 1,000 mi. Curved sheets of plastic in the model, formed in hyperbolic and parabolic shapes, represent phase and timing measurement made by Mitsun. The fire stations are expected to be only for an first operational test with a 1987. The system does not require precise tracking stations but does use a low-cost radar which tracks the missile and provides signals for locating moving stations at risk of the stations.

Missile Position-Finding System Detailed

By Philip J. Klein

New York—Test details on a new air-crown missile trajectory measurement system scheduled for Atlantic Missile Range, which is expected to be considerably more accurate than without new in use, were disclosed here last week by General Electric, which will build stations for the Air Force.

USAF's new missile trajectory measurement system, known as Mitsun, is an outgrowth of the radar command guidance system developed for use with Atlas ICBMs by GE's Defense Systems Department. Mitsun is to be installed in AMR next year.

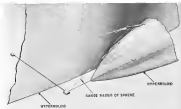
Initial Mitsun installations, scheduled to begin first operational tests in 1987, will provide accurate coverage over a distance of more than 1,000 mi. Initial installations will consist of a central station at Cape Canaveral plus four remote stations laid out in the shape of an "L." Two main remote stations on each leg of the "L" will be spaced 10,000 ft. from the central station, while auxiliary stations will be 100,000 ft. distant, or approximately 20 mi.

Accuracy of the Mitsun system is not disclosed for reasons of military secrecy. However, the velocity error of an ICBM must be held to less than 0.01% if the missile is to hit within one mile of its target (AW Jan. 16,

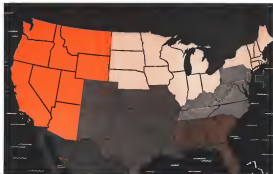
1975, p. 217). Therefore any system designed to track ICBM guidance must have somewhat better accuracy than the system being tested by at least a factor of 5:1.

Accuracy of the initial trajectory system can be increased through the installation of additional remote stations at greater distances downrange and along the Atlantic coast. GE anticipates an extension is planned for the future.

Radar technology used to determine missile position and velocity will be incor-



MISSILE TRAJECTORY MEASUREMENT SYSTEM distances distance to missile from central station and difference between the distance and missile's distance to each of four remote stations (line of which are shown above). The distance-to-central station measurements double a signal (shown above) that while each of the distance differences double (shown above) the distance of the first (shown above) establishes missile's position. Mitsun is equipped with transponder.



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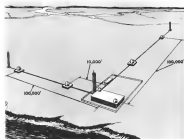
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METRAM stabilization study will consist of central station plus two remote stations laid out in shape of an "E," with two of the remote stations roughly two miles out and other two situated approximately 30 mi. distant. Later plans call for additional remote stations to provide greater accuracy.

using the relative phase of signals received at each of the stations from a radio transmitter located near the stream. The receiver's accuracy is determined by measuring rate of change of its position, rather than by duplicate shift technique employed in the original Metram system.

Establishing Position

Metram position is established by measuring its distance from the central station and the distances between the stations and the receiver's dot was from each of the four remote stations. The latter measurements are made using a continuous wave (CW) carrier and "V" in each high efficiency modulation system, GE says.

The distance measurements, made from the central station describe a sphere, while the distance differences measurements make the remote stations describe a hyperboloid of revolution. The intersection of the sphere and two hyperboloids of revolution provided by the two remote stations are sufficient to define the receiver's position in space, but the two additional hyperboloids provided by the other two remote stations serve to improve accuracy.

Subsequent installation of additional soundings and ground remote stations can provide still better accuracy.

Metram will incorporate new phase stabilization techniques which make it possible to use extremely long base lengths for locating remote stations occupying a previous location of well-transmitter-type measurements and

most according to GE. The new technique, developed by company's Dr. Louis J. Nordin, permits almost infinite extension of station baselines, GE says.

The new system does not require precision locking receiver but does require a few square miles which tracks remote and provides signals for measuring moving stream at each of the stations.

Industrial accuracy of a system such as Metram depends upon the precision with which each station location can be determined. In addition to using conventional measuring techniques, Metram should be able to obtain extremely accurate measurements of station locations using signals from ground transmitters utilizing GE sets.

Center Will Analyze ICBM Infrared Radiation

Metram, Metram Research Center will collect analysis and correlate data about infrared signals emitted by ICBMs and IRBMs in an effort to develop mathematical models describing missile behavior.

Comparison of stellar data from an analyzer made with the model reveals they help identify the missile. The Center is located at the Infrared Laboratory of the University of Michigan's William B. Ross Laboratories in Ann Arbor, and is supported by \$268,000 in Advanced Research Projects Agency funds from a contract with the Air Force's Geophysics Research Directorate.

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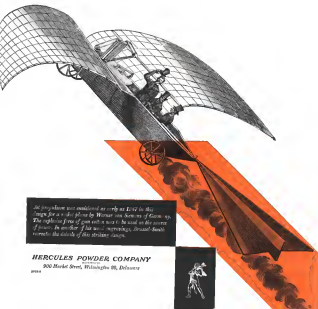
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Since Creation, man has looked out on space. At first, unknowing and incurious; then with the beginnings of understanding; now free and able to explore. Yet to move in space calls for wholly new concepts of energy.

Thus, then, is the working philosophy of Hercules in chemical propulsion: To design and manufacture highly concentrated packages of energy as propellants and rocket motors; each dependable, controllable, predictable, and each perfected for its specific mission.

HERCULES BACKGROUND: A half-century of creative imagination in the evolution of propellants, from shotgun powder to the manufacture of the propellants for all the U.S. rockets fired during World War II, and now to space propulsion. Hercules provides total engineering research, design, engineering, and staff organizations for the production of the most advanced propellants. Brochures available on request.



The propellant was mentioned as early as 1837 in the design for a jet plane by Werner von Siemens of Germany. The explosion force of gun cells is used to be used as the source of power. In another of his most surprising, almost-fanciful concepts the details of the struts, clamps.

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Circle 1



PDM pulse timer for checkout, calibration and evaluation of telemetry discrimination equipment. Sometimes also can generate word-coded signals for data. Element concentration modes and one channel. Autotransmission built-in measuring channels, commutator speed variations, duty cycle variations, logic, buffer, menu, and fading. (Via through 100 channels/trace, standard counter tube rates from 75 to 900 channels/sec and 60 to 900 PDM duty cycle can be selected. Electro-Mechanical Research, Inc., Somerville, Pa.)

• **Crystal Filter, No. 8P-10000-45**, is 10-mc center frequency bandpass precision filter developed for use with non-automated RF amplifiers and packaged in hermetically sealed metal capable of withstanding 100 shock. Filter has 35 lb bandwidth at 6 db points and 50 db at 60 db. Ripple is 1 db and stopband is greater than 70 db. The filter packaged in 1-in. x 1-in. x 2-in. unit. Sylvania, Inc. 1400 Decatur Dr., Orlando, Fla.

• **Demodulator/Phase Detector, Model 188A**, has use in data transmission, receiving, recording systems, computers and guidance systems. provides d.c. output proportional to any amplitude/phase difference between the 15 volt, 500 cps reference input and one to 15 volt, 500 cps. signal input. Noise is 10



microvolts maximum for 500 ohm or center connected to input terminals and 15 x rms, 500 cps. applied for reference. Divid is 0.2 and noise rms, 10 to 500 cps for constant 15 x rms, 500 cps. signal applied to reference and constant 10 x rms, 500 cps. applied to input. Vaco Mfg. Co., Inc., 2700 Walnut St., Garland, Tex.

AVIATION WEEK, July 18, 1960

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The answer—feasible. Carrying a simulated missile and sensitive oscillograph recording equipment, an FMC tracked vehicle ran a 2,000-mile shock test over our proving ground—an 60° slope, over rough cross country terrain, and on high speed roads. Data returns showed that the vehicle's torsion suspension system effectively cradled the missile, with a low shock input factor.

For full details on these tests and other questions of adopting tracked mobility for your purposes, contact FMC, America's leading producer of military-standard tracked vehicles.

For further information, write, wire or phone
Preliminary Design Engineering Dept., FMC
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California. Phone: CY 4954 4-8124

Putting Ideas in Work



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Illustrated below are the M-118 and five vehicle adaptations of this basic tracked vehicle. All of the vehicles use the same military standard equipment, including engines, power train, and suspension components, thus reducing the military logistic burden and R&D costs in weapons systems.



FMC's New Liquid Propellant Metering System Achieves Accuracy to $\pm 0.1\%$



Mobile metering and control unit for fueling liquid propellant missiles

The crucial reliability of missile systems is influenced by the accurate measurement and delivery of liquid propellant to the missile tanks. For example... a small error in fuel weight could adversely affect the in-flight performance of the missile, causing possible failure of the entire mission.

Food Machinery and Chemical Corporation's Ordnance Division has recently developed a mobile liquid propellant metering and handling system which promises to solve many missile fueling problems. The advantages offered by this unique new system are many.

Accurately measures and records the amount of fuel delivered to the missile tanks. Original specifications called for a metering accuracy of $\pm 0.2\%$. Extensive tests, performed by previous test equipment, show that the system is capable of metering and delivering missile propellants with far superior accuracy—to $\pm 0.1\%$.

Automatically compensates for factors influencing fueling accuracy. The fuel is continuously sampled and the flow corrected for variations in temperature and density. In addition, the fuel which vapors in the missile tanks is returned to the system, measured, measured, and an equivalent amount added by the metering unit.

Adaptable to many different missile fuels. The system is designed to handle such storable liquid propellants as hydrazine, nitrocellulose, nitroethane, Dinitroethane (UDMH) and nitric acid.

Economical to manufacture and easy to operate. To reduce development, manufacturing and operating costs, the system makes maximum use of standard, interchangeable, and commercially available components. The simple and safe design eliminates human errors and danger to operating personnel.

Mobile and compact. All metering, pumping and control equipment is mounted on a single, portable trailer. The complete unit may be easily transported, rapidly positioned, and provides a single station for the metering of fueling operations.

The successful development of this mobile metering and handling system by the engineering staff of FMC's Ordnance Division is another achievement made possible by utilizing the unique capabilities of chemical and mechanical engineering talent available at Food Machinery and Chemical Corporation.

BUSINESS FLYING



MODIFIED German FS-24 Polaris glider flown by Eusebio Glaser (shown) at Poland's new T-1 and retractable landing gear.

World's Gliders Vie in West Germany

By Edith Wallrod



RUSSIAN AGASTRA was designed by Richard H. Johnson, U.S.A., who took 128 places in the open class. Aircraft's span is 78 ft., length is 25.4 ft. and wing area is 151.5 sq. ft.



SED-EDIE took second place in the open class, flown by Edward Mielke of Poland. It's completely sleek, close least created favorable comment. The 26 ft. has a 35.5 ft. wing span, measures 21 ft. in length and has a wing area of 150.5 sq. ft.

Butterflies, West Germany—West Germany's Hans Huth and Argentina's Rudolph Homberger took top positions in standard and open class respectively at the Eighth World Gliding Championships here.

George Mincek Beard, and Adam Witke, Poland, took second and third places in the standard class. Two other Polish pilots, Eda and Mielke and Jerry Popel, placed second and third in the open class. Names of second and third place winners in both classes were reversed in a previous report (AVW June 27, p. 38).

The toughest contest, which was preceded by a one week practice period, was organized by the German Aero Club under the auspices of the Fédération Aéronautique Internationale. Five European 30- to 40-year-old pilots flying the latest glider designs from some of the 24 countries represented, it was the toughest most comprehensive international gliding contest ever held.

First international, among competitors was held in 1937 in Germany, cradle of gliding.

Glider Restrictions

Two classes, open and standard, were admitted to the competition this year. The open class is subject to no restrictions and pilots may use radio. Gliders in the standard class may not have a span exceeding 66 ft. (15 meters), and retractable landing gear, retractable wing area, or section, and use of radio equipment are excluded.

Twenty gliders were entered in the open, 35 in the standard class. Originally, 27 countries with a total of 47 gliders entered the contest. But of the

for these Eastern countries expected, only the Polish team and one of the three Yugoslav pilots actually arrived.

The organizers requested all pilots to obtain in advance visas for every country landing on West Germany, to provide security in the event a forced landing or subsequence of flight regulations brought fire of the participants beyond the German frontiers during the contest.

Soviets Protest

The Russians claimed inability to fly two times in three. They also protested against the employment of "soften aircraft"—FS-24s—on loan from the German Luftwaffe and other aircraft for towing purposes. The German Aero Club replied that nobody in West Germany other than military authorities could get such a large fleet of triplanes at the disposal of the Rostovskiy meet, and that in any case this was in accordance with normal practice of other countries on such occasions.

The Hungarians explained they were unable to come because they had not completed construction of the new sail planes they were hoping to introduce at the Rostovskiy meet.

Neither the Czech team nor the two missing Yugoslav pilots arrived themselves, but it was generally assumed they had found participation too expensive. Rumors at home predicted the one Canadian pilot, Glen, from coming.

Required Missions

In accordance with FAI Gliding Commission rules, a specified mission was scheduled on certain days of the contest for each of the two classes of gliders, weather permitting. Obligations were assigned a few distance flight in one direction as well as a goal in sail and cross-country race, and a distance contest over circles 100-200 or 300 km with an intermediate heading.

Gliders were launched in the FS-24s on Dec 27, aircraft in open categories on the six or days in which favorable weather invited the competition.

Leader in the open class by the end of the first week's flying was Britain's Nicholas Goodhart on his Illbruck Olympia 439 sailplane. He led on two of the six days of competition, but his opponent lost points for admitted cloud flying on one occasion and voluntarily withdrew.

He placed fourth with 4,556.6 points in the final results.

The first week's performance had stressed the opponent's opponents of the Polish two with their new, sleek, high performance Zeke (open class) and Pole (standard class) sailplanes. Their seemingly effortless lead by the end of the fourth day was an indication to most



UNIPAC on the opening day of the 1968 Eighth World Gliding Championships at Puchberg near Cologne, West Germany. German FS-27 tow planes are at upper left.



POLISH SED-EDIE was piloted by Adam Witke to third place in the standard class. Reduced height at the Puchberg explains the pilot to be the cockpit. Hungarian Puchberg (below) was flown by Jolo Amoros, Argentina, in the standard class. Span of the Puchberg is 49 ft., 2 m., overall length is 24.4 ft., wing area is 121 sq. ft.



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INTERIOR panel of the all-metal Yagorukh Meteor 60 is shown at left. The glider, built in 1936, was flown at Bielefeld championships by Joe Maki, the only member of the Yugoslav team to appear at the competition.



spectators that the Polish pilots would pocket both championships titles. The climatic victor of Kaspilpho Hangeur, German pilot of the South Old Cypriote in the Argentine, was consequently quite unexpected.

Standard Class Title

First Center House, 1938 open class world champion at Lermo, Poland. Bying for the first time a modified version of the all-synthetic FS 24 Polaris glider first introduced at Karlsruhe Fashidex last year (AW Aug. 17, p. 119), was only worth with 4,004.9 points. Among other slight changes, the Polaris is now fitted with a T-tail and retractable landing gear.

Throughout the contest the main struggle for the standard class title was

between Adam Witek of Poland 1953 standard class world champion at Lermo, and German champion Heinz Harb.

The Kaiser Kuck RK, at which Harb finally won the event, took all five top places in the standard class this year.

In the opinion of the German Aero Club, it was not the U. S. team's lack of skill that placed the three pilots only 15th in the standard, 15th and 16th in the open class of the first month. Some European experts persist in believing that the light German gliders are unsuitable for most American sailplane designs. They do much better at home where they can fly higher and further over wide open usually wooded terrain in more stable weather. A couple held in the U. S. outlying zone of the best

European glider types would soon prove this point, they said.

The U. S. team's captain was Paul A. Schneider, vice president of Schweizer Aircraft Corp., Elmira, N. Y. Richard H. Johnson, holder of the 1955 world distance record and U. S. sailing champion Eric Smith, finished 1,997.5 points in the open class in a new, T-tail RH 6 Aderos sailplane of his own design.

Self-Designed Glider

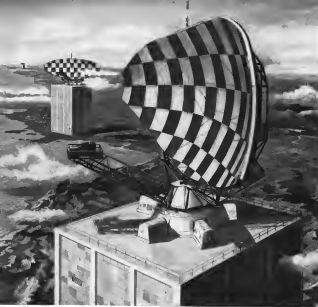
Richard E. Schrader, U. S. A., scored 2,801.4 points in the open class in his self-designed Air Mule EP-5 glider. Schrader is holder of all three official world class world record records for 100, 250 and 400 km.

Third American pilot was Paul Balle, head of the National Aerobatics and



TAIL SECTION of the all-metal Yagorukh Meteor 60 is shown at left. Tail section of the new standard class SZD Polka, a Polish entry, features a swept vertical surface (right). SZD Polka came in 49 ft. 2 in., length is 25 ft. 6 in., and wing area 170 sq. ft.





The art of precise detection

Dominating the environment is a Sperry Air Search Radar—one of a network which will strengthen America's Central Aircraft Control and Warning System. Twenty-four hours a day the year round, these giant radars stand guard scanning the skies for possible "hostiles."

This is one of many advanced Sperry radar systems. Others are tracking and guidance radars for the Navy's Torpedo and Teller missiles . . . airborne navigation and weather radars for the Air Force . . . portable and portable tactical early warning radars for the Marine

Corps. They battlefield surveillance radars for the Army front-edges. And in commercial shipping, Sperry radars are proving all types of vessels from the luxury ocean liner to the harbor tug.

Sperry contributes its radar and component technology in such fields as microwave instrumentation, keynotes and tracking wave tubes, ferrite devices, semiconductor and solid state active speechfield effects related to radar continue to advance the art of precise detection . . . and direction. General offices: Great Neck, New York.

low the aircraft's best climb, only a 1000 ft/min climb rate. The aircraft also had a 1000 ft/min climb rate. The aircraft also had a 1000 ft/min climb rate. The aircraft also had a 1000 ft/min climb rate.

In that project conducted with the Civil Aeronautics Administration, students with no flying experience had an average of about 10 ft/min climb rate. The aircraft also had a 1000 ft/min climb rate. The aircraft also had a 1000 ft/min climb rate.

"There appears to be a psychological factor present since the new student seems to accept the instrument as a part of the airplane instead of a thing apart. In fact it was found that most of the students performed reasonably well previously to the instrument training, but when using visual references and performed during the instrument training to reference to the instrument," according to one of the instructors in the program.

Training Study

A follow-up study conducted at the same center but with model students with previous flying experience and produced the conclusion that previous cross-country flying experience is of no value in the instrument flight student. Based on the earlier study, the report said, such experience would be a disadvantage, and instrument instruction is best absorbed in the private stage of private instruction. Instruction in the 1970 program found that the average successful pilot can be taught to fly on instruments and maintain the basic instrument cross-country in less than 10 hr.

FAA's current requirement also is that a minimum requirement of 10 hr instrument flight experience, plus a demonstration of cross-country flying, for a commercial pilot's license. FAA included requirements because the new student certificate covers piloting on cross-country.

Inclusion of the instrument requirement does not qualify private at all, but it is hoped that pilot can plug with the new regulations will be encouraged to work toward a more recent rating.

Since the establishment of the FAA the Civil Aeronautics Board has been

responsible only for the investigation of fatal accidents involving aircraft weighing 12,500 lb or less, but the Board keeps records and analyses all aircraft accidents in this weight category. FAA investigates the actual accidents and issues the reports to the CAB.

Accident Reports

Here are some examples of CAB accident reports which highlight FAA and Weather Service concerns for the private pilot's instrument abilities.

On a VFR flight from Springfield, Mo. to Kansas City, Mo., the pilot of a Piper PA-34 departed to Kansas City, Mo., because of weather at Kansas City. At last contact the pilot asked the status of the Columbia VOR, was told it was normal, and was given

landing guidance. The flight was reported missing and the wreckage was found two days later in an open field approximately 10 mi east of the Columbia Airport. The Board's analysis found that the pilot, not qualified for instrument flight, flew into the ground in instrument weather and also had disregarded advice to postpone the flight on the face of existing unfavorable weather.

The pilot of a Beechcraft D-35, carrying three passengers, became lost while attempting to locate the Landing Area, KJ, airport under below VFR conditions at night. While trying to reach the airport, the aircraft, the aircraft crashed and burned in a falling terrain. The CAB pointed out that the pilot did not hold an instrument rating and

Aircraft, Parts Exports

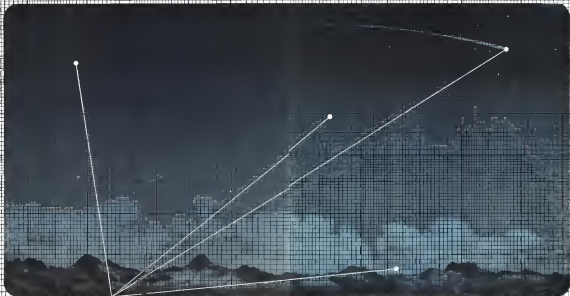
Exports of Aircraft, Parts, and Accessories from the United States: Quantity and Value February and March 1968

Item	March 1968		Cumulative totals Jan.-Mar. 1968	
	Quantity	Value (\$1,000)	Quantity	Value (\$1,000)
Aircraft, parts, and accessories, total		133,468		387,331
Commercial and civilian aircraft, total	712	67,073	474	67,074
Aircraft 1,000 lb. and over empty airplane weight—				
Cargo transport, commercial, new				
3,000-14,999 lb. empty airplane weight	0	360	10	1,432
15,000-24,999 lb. empty airplane weight	1	419	5	890
25,000 lb. and over empty airplane weight	0	0	17	75,934
Military wing aircraft, commercial, new				
Commercial and civilian aircraft, used and rebuilt, including converted	10	1,461	20	3,082
Aircraft under 1,000 lb. empty airplane weight				
Biplane, commercial and civilian, new	21	660	66	676
3 places and under	100	1,700	100	1,561
4 places and over				
Military wing, commercial, new	4	201	7	382
Commercial and civilian aircraft, used and rebuilt, including converted	34	1,400	61	416
Commercial and civilian aircraft, new, n.e.c. (all empty airplane weight)				
Aircraft engines, reciprocating, new air-cooled				
under 400 hp	108	240	306	761
Aircraft engines, reciprocating, used and rebuilt	110	482	322	2,570
Aircraft complete parts, and accessories, n.e.c.		94,724		168,640

Source: Foreign Trade Division, Bureau of the Census

¹Air-cooled reciprocating engines, new, 400 hp. and over are included in "Aircraft complete parts, and accessories."

²Includes military aircraft.



**PRECISE
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IN SPACE...with New Westinghouse Radar Technique**

■ An entirely new Westinghouse radar technique now under development at the Electronics Division will sharply increase the accuracy of radar detection, identification and tracking of objects in space.

Utilizing a single radar, the Westinghouse technique opens the door to many important new applications. Among them are accurate measurement of objects in space, satellite re-

connaissance, air-to-ground surveillance and mapping and ground-to-air tracking and identification.

We would be pleased to discuss these new developments with qualified persons on a classified, need-to-know basis. Contact: Marketing Manager, Electronics Division, Westinghouse Electric Corporation, Baltimore, Maryland.

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Westinghouse
ELECTRIC

PROBLEM?



ground weather warnings that his destination would go below VFR minimums after sunset. Cress was killed in an instrument pilot loss incident while attempting a night flight in instrument conditions.

A Cress 199 was climbing through a layer in the overcast near Lake Placid, Calif., and when it cleared it, the pilot attempted to continue the climb on instruments. However, he suddenly feared that he had not maintained his heading and tried to turn back. The aircraft rolled with loss as a maneuver and disintegrated. Probable cause listed by the Board was that the pilot not qualified for instrument flight, continued flying in instrument weather.

Instrument instruction

Now Germent, II, the pilot of a Cress 198, carrying five passengers, continued a flight in instrument conditions although he was not instrument qualified. The wing of the aircraft was torn off in flight and the fuselage was seen to dive from the low overcast and crash in a forest field. A short time before the pilot took off on the outgoing portion of this trip, he was given instruction in instrument flight (under the hood) and had been unable to maintain control in level flight or to hold a heading. Probable cause listed was that the pilot unqualified for instrument flight, attempted to continue flight under instrument conditions.

PRIVATE LINES

University of California's Institute of Transportation and Traffic Engineering is conducting a study of private aviation in California to develop an inventory of airports, a count of privately-owned aircraft by type, and data on the "when" and "where" of flying, according to trip purpose—pleasure, is structural, commercial, or business. Study cost is being shared by State Senate Committee on Transportation and Public Utilities.

Piper Aircraft Corp. has entered the aircraft field with purchase of Aero Signal Laboratories, Phoenix, Ariz. The acquisition is being moved to Piper's Research and Development Center at Vero Beach, Fla., where its principal product, a low-frequency radio direction finder called the Arcturus, will be manufactured in an adjacent equipment area on all single-engine Piper aircraft.

Altitude deployment airplane, the A-11, has been developed by Soviet aircraft designer O. K. Antonov, who claims that it has a maximum speed of 355 mph. Gross weight is approx-

imately 932 lb., gross is 55.5 ft. and length is approximately 23 ft. Soviet press reports that the new multi-component fuselage with the high-performance French Rogues 901 airplane Antonov's earlier A-11 airplane has been enough, criticized for not meeting claimed performance.

Boeing dealer heading program (AW Feb. 21, p. 95) has accounted for adding 35 new domestic sales and service organizations to the company's order base for this year for current or low high total of 118 with further increase continuing.

Valiantair Helicopters, Inc., Knoxville, Tenn., is a new entry into operations which has purchased a Bell 430 for ground observer, passenger survey and other duties. Plus outside service to transport air passengers from Knoxville Airport to destinations in or out of state, compared with approximately 45 now acquired by other means.

Fuller's warranty has been established by Tecton Inc., on its "Cold Seal" T-3 three-axis automatic pilot covering gyro instruments, components as well as other items in the system.

Three Cessna 180D lightweight business planes have been formed under the Atlantic for delivery to the company's dealers and distributors in England, Switzerland and South Africa. Cessna has formed a new marketing division for handling worldwide manufacturing and marketing of all its commercial aircraft products. New division managed by Frank Martin will prepare for future sales expansion and new product under development.

Flyer Apache Model G (AW Mar. 5, p. 151), which features improved canopy design and lighter radio pressure, has entered production. Flyer also has improved electronic heat system and increased gross and flap extension speeds.

Genome Co. of Hamilton, Ont., Canada, has become senior and parts distributor for Moavia Aircraft, Inc., airplane in eastern Canada. Charles Collins is chief air engineer, and Ted Delaney is Hamilton branch manager.

Four-engine Lockheed JetStar is custom transport has been purchased by ENAM S.p.A., a wholly-owned subsidiary of Itak's state-owned petroleum company, Enak, Novosibirsk, Siberia. Firm will use the purchased plane for flights over Europe, Asia, Africa and South America. Delivery will be made in mid-1981.



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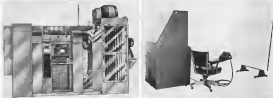
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EQUIPMENT



PHOTOGRAPHIC processing system components include variable speed processor, left, capable of handling film lengths of 1,350 ft. Glossy printout system, right, permits study of a 10% magnified image by aerial photo interpretation.

USAF Studies Satellite Film Processor

Automatic film processing to handle the vast quantities of film produced by photo reconnaissance satellites is being evaluated by the Air Force. The ground handling system will automatically process, index, reproduce and display 70 mm. high resolution panoramic aerial photographs.

The aerial reconnaissance ground handling system, developed by Intel Corp., Waltham, Mass., is being tested at the Air Force Aeronautical Ground Information Center, Vint Hill, Va. The prototype system processes duplicate film for viewing or plotting from one film in about two hours.

Rapid Processor

The Intel film processor is not intended to provide rapid processing of small amounts of film. Aerial reconnaissance film can be interpreted while wet when first received from the aircraft (AW June 20, p. 149). A rapid processor developed by Chicago-based Infraredics may permit automatic airborne processing for immediate interpretation upon receipt from photo planes.

The automatic ground handling system is needed to provide the capacity to process and index the large quantities of film generated by an aerial reconnaissance satellite or an "open skies" aerial inspection plane. Without a rapid processing capability for the large quantities of film produced, such satellites and planes would be of little value.

The prototype system operating at Vint Hill includes a variable speed processor, a film index, contact duplicator, contact printer, individual scan-

nerization viewer film measurement, projection viewer, slide enlarger and scan stage enlarger.

The processor, a variable speed type, handles high resolution photographs of 100 lines per inch. Film speed range can be varied from 0 to 80 fpm. The processor will accept up to 2,500 ft. of film in a single loading and new film may be spliced in without interrupting the processing. Film must be loaded in dark or subdued light.

The film index, which provides by film markings at speeds to 1,600 fpm,

employs a gold foil system to imprint an identifying code on the original negative. The system's contact duplicator is designed to reproduce color contact lengths of positive and negative materials up to 1,600 ft. long, print at speeds from 10 to 75 fpm, and maintain resolutions exceeding 100 lines per inch through three generation films.

The viewing station transmits original panoramic frames photographically into a plotting workstation. This permits accurate plotting on the photo-



INDIVIDUAL scanframe views is linked with a two-coordinate analog computer to obtain actual ground distances on the basis of projected range measurements.



BENDIX STARTER-GENERATOR PROVIDES "KICK" AND POWER FOR U. S. ARMY'S NEW "MOHAWK"

One of the largest aircraft ever to enter Army service, the Grumman AD-1 "Mohawk" has all-weather, day or night observation capabilities.

The "Mohawk's" electrical system includes two Bendix starter-generators and regulators. During engine starting, the units operate as high torque electric motors, with power supplied externally. As the engine operates, the units automatically shift from starter to generator function.

These Bendix starter-generators are rated at 300-400 amps, with a speed range of 4,000-6,000 RPM, and meet MIL-G-6052. They are available with a variety of air speeds and have accommodations for QAD mounting.

This versatile package, combining starting and power generating functions, is another example of Bendix ability in delivering power requirements. For further details from RED BANK GENERAL PRODUCTS DEPARTMENT.



Bendix dual pump 20000 series generator unit. 12 in. h. at coupling flange; at 1400 RPM it is 14 in. h. maximum; voltage and output vary 10%.

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Current Tester Cuts Maintenance Costs

By Richard Sweeney

Los Angeles—Nondestructive test review for airplane structures and parts, designed around electrical eddy current theory, is cutting maintenance and material replacement costs for Coastal Air Lines and other air carriers.

The equipment was designed by Magnetics Corp., and development was a joint effort by Magnetics and United, with the air carrier designing a number of applications for the system which include:

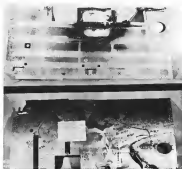
- Testing for structural soundness in hard-to-reach locations in aircraft
- Testing parts and components for hidden defects
- Testing parts and material for incipient failure
- Testing parts and material which may look alike yet be of different material or of the same material with different properties such as hardness

Eddy Current

Eddy current is the phenomena wherein when a coil is applied to a piece of conductive material, a current flow in the material is set up but in a direction opposite to that of the coil, i.e., a right hand-wound coil would induce a left hand turning eddy current. The eddy current is significantly affected by the properties and condition of the material, such as cracks, soft spots, corrosion. The eddy current circuit emulates use of a bridge, with a readout dial included in the circuit, and the readout values indicate the changes from normal in properties affecting conductivities of the piece being tested.

In an application development, United Air Lines put a Magnetics eddy current test unit to work at its San Francisco maintenance base some time ago, specifically designed for and aimed at one job—inspecting for and detecting cracks emanating from the crack plug boxes of R-7300 engine cylinders. In addition to detecting crack patterns, the unit was designed to measure their depth accurately. Installed on the powerplant overhaul production line, the tester was unworkable for development of new applications.

Basically, the tester consists of the radiating and circuit coupling unit, plus a probe containing the coil. Probe configurations change according to the type of work, to be done—detect cracks, test materials. When the probe is applied to a test piece which contains some kind of fault the impedance created by the fault shows up as an impedance on the impedance and is reflected in the self-resonant bridge circuit.



EDDY beam is Norferry F-29 which was damaged by internal fire at 501 in. thick 70% T4 Alclad aluminum alloy. Bottom photo shows cracks which eddy current testing showed to be caused as a result of the fire, and needed replacement. Top half of picture shows the mechanical unit which proved to be invaluable after the part was removed.

For United's test work, the probe was designed for the plug box testing. When the airline added additional work several probe configurations were also adopted, which were shaped according to the type of work and test piece, such as turbine wheels, jet engine turbine wheels, aircraft wing spar caps and test wires.

Eddy Tester

United was able to use the eddy tester, called ED-100 by Magnetics, in various crack depth accurately to the extent that results frequently was automatically determined as well, a test which was impossible using any previous inspection techniques. The saving in direct inspection time ran from 25 to 30 minutes from 30 to 40, while material saving was effected through longer use of cylinders before radial cracked aircraft propellers. Additional saving was effected through not having to make cylinders when the crack depth exceeded airworthiness limits.

Development of additional probe configurations enabled United to extend its eddy testing to turbine wheels, where cracks frequently were aided by dirt, oil, grease and rubber from the

rim. Cleaning wheels was not completely satisfactory, especially when crack filling was needed as in first and previous such as a hardened leading edge in cracks did not allow eddy testing in the same way, cracks were detected and depth assessed.

While developing the eddy current



EDDY current tester is used to detect flaws and cracks in metal area where most holes have been bored. Previously, such metal parts had to be removed for inspection.

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For additional information on the Model 344 Load Cells or for the answer to a specific load cell requirement, write:



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test techniques. United found some difficult problems, a primary one being that different inspectors handled the probe differently, thus readings were different for the same test piece and probe when several inspectors did the work. One design feature of the Mag-naflex equipment is a "blind" feature, which enables the user to test rough, surface pieces, or conducting material pieces over which coatings have been applied like paint or enamel.

Test Criteria

The referee finally established basic probe-handling techniques and criteria then assembly of standards to determine standard readings for the fluxless specimens of each piece on which the test was made began. Over a period of time, the referee has been able to determine that when testing the left ribhead main landing gear wheel of a C-130, a flexure piece produces a certain reading, while a stack of rivets disassembled is acceptable according to the reading, although a cut, which looks the same but produces a

different reading is unacceptable and the wheel needs replacement, painting or repair.

Extending the applications, eddy current's predictable reactions have enabled the tester to act in a material sense, such as separating a batch of 4-in. dia. head bolts of the same length where some may be titanium, some carbon steel and others chrome moly steel. Similar advantages can be taken of the various conductivities of sheet metal of various alloys. A variation in this is using the eddy current tester to detect such flaws as soft spots in steel pieces or porous spots in castings, or worn or fatigue-induced spots on various parts and components where the material's basic crystalline structure has been altered by stress in a degree where conductivity is changed.

Among airlines now using eddy current testers, according to Mag-naflex, are United, Trans World Airlines, Northwest Airlines and Northwest Orient Airlines, and Pacific Aerospace Corp. which was the user in a cockpit repair overhaul facility.



Boeing Delivers Atlas Silo Cylinders

Atlas silo air spring support cylinders, used to keep the silo floor level at all times and to provide a spring cushion for the atomized-silo-belted missile, are being delivered by Boeing Airplane Co.'s Wichita Division. Large lifts in form of the cylinders are part of Gyroco which consist there to the silo Boeing Corp. of Engineers controls, worth \$2 million, will be produced of 75 support cylinders.



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Baggage Inspection X-Ray

X-ray and fluoroscope baggage inspection unit is designed to provide rapid inspection of airline baggage.

The inspection unit permits direct viewing, closed circuit television viewing or still radiis a permanent record on 70 mm or 16 mm film. The equipment is 57 in. high, 62 in. long and 32 in. wide.

The unit cost is \$6,500 to lots of as as one. Leasing arrangements are available.

Daly Industrial, Niles, Ill., 702 Franklin St., Building, Los Angeles, Calif.

Oxygen Test Stand

Stand is designed to test aircraft oxygen system components. The stand was designed specifically for the oxygen system on jet transport aircraft.

Model A211 oxygen test stand consists of an oxygen cylinder supply and gauges, regulators, valves, flowmeters and



extensometer to check component performance. Four oxygen cylinder supply two pressure regulators which control discharge pressure to 12 outlet valves. Also two regulated pressure ranges are 0—500 psi. and 0—2,100 psi.

Trio-Tech Co., 3098 N. Anson St., Burbank, Calif.

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the outer shell. The woven construction is used to meet the temperature limitations of bonded node core and exceeds the specifications of MIL-C-8871A. Both glass fiber and aramid fibers are being combined with such resin systems as phenolics, phenylepoxy, epoxies, polyimides and epoxies. H. I. Thompson Fiber Glass Co., Los Angeles, Calif.

Flight Test Camera

Camera, mounted in the nose of an aircraft, captures aircraft and landing characteristics of test aircraft. A collection of 6750 ft test tape over photographic tracking is cleared with the use of the camera.

The camera takes three photos simultaneously, one straight down and one to either side. The images are recorded on one film. Test information is transferred by a hand strike light on the film images. Working with known runway dimensions, engineers compute velocity, acceleration, altitude, and roll, pitch and yaw angles from the film record. The 35 mm camera is sold for \$7,500.

Lukheed Aircraft Corp., Burbank, Calif.



Fueling Bags

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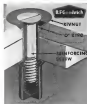
Bosch Filter Division, Madison Heights, Mich.



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Three-stage helium regulator is designed to control missile fuel tank pressures. The design is used to maintain the effect of large flow ranges and variations in temperature and altitude pressure.

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Dyna-Matic Corp., 11679 Shiloh St., San Valero, Calif.

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primary unit designed for wide variation in discharge rate (up to 100 mA continuously). Sections "A" and "B" each consist of 20 cells of 5 amp-hr nominal capacity. The 22 lb battery is 5 in. wide, 6 in. high and 15 in. long. Yenching Electric Corp., 40-50 Looe and St., New York, N. Y.



VOR Indicator

Transistorized VOR indicator with a guaranteed accuracy of 2 deg. agrees with any standard VHF receiver.

The Nav-Air one indicator weighs 12 oz. and fits the standard in-strut hole. The navigation indicator is also used as a second unit for instrument flight as a primary unit for aircraft fitted with a VHF radio (see p. 518).

Nav-Tech, Inc., 1733 Sepulveda Blvd., Manhattan Beach, Calif.

Liquid Propellant Cartridge

Liquid propellant gas cartridge develops high gas-flow pressure to operate pneumatic power-actuated devices. Applications include emergency activation of landing gear.

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clean burning characteristics, low flame temperature compared with solid and a gas expansion ratio of 14,000 to 1. Ignition is used to be reliable between temperatures of -105 and +221°F. Igniter can be electric or pyrotechnic true primer. Cartridge is smaller than a flashlight battery.

Ona Matthews Chemical Corp., 400 Park Ave., New York 22, N. Y.

WHAT'S NEW

Reports Available

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C. Emergency Escape Capsule Studies—Phase I. Preliminary Laboratory, Flight-test Studies—by A. F. Kermacy and others, Aero Medical Laboratory, Wright Air Development Division, USAF, June, 1959. \$75, 21 pp. (PB 161042)

Development of an Emergency Ejector Seat—C. C. Lutz, Aero Medical Laboratory, Wright Air Development Division, USAF, Jan. 1959. \$75, 21 pp. (PB 161033)

Aerodynamic Phenomena in Steep Atmosphere—A. Birkhoff—by Buckle

Laboratory, National Bureau of Standards, September, 1959. \$1.25, 95 pp. (PB 151350)

Bibliography on Gas Lubricated Bearings—Rettlerin, E. E. Smith, Air Franklin Institute, September, 1959. \$2.50, 107 pp. (PB 161817)

Tensile Properties of Aircraft-Structural Metals at Various Rates of Loading After Rapid Heating, Part II—by J. R. Kottan, Southern Research Institute for Weight Air Development Division, USAF, February, 1959. \$3.00, 157 pp. (PB 151695)

Flight Test Insulation Studies—by A. G. Nason, Control Weight Corp. for Wright Air Development Center, USAF, February, 1959. \$2.00, 71 pp. (PB 161679)

Present Status of and Future Outlook for All-Metal Sandwich Construction for Air Vehicles—by W. A. Treadwell and others, Standard Research Institute for Bureau of Aeronautics, U. S. Navy, August, 1958. \$2.75, 144 pp. (PB 161099)

Notes on Dynamics of Linear Elastic Structures—by G. J. Oliver, U. S. Naval Research Laboratory, October, 1959. \$7.50, 79 pp. (PB 151915)

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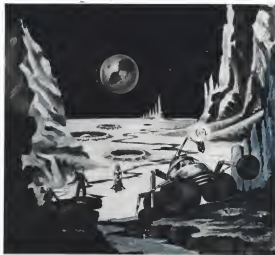
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A BORG-WARNER INDUSTRY



PROPOSED airborne rescue range station version of the Boeing C-130 would require addition of long dorsal blisters to accommodate life-support systems and optical instrumentation outside the normal left line of the fuselage. Also added is a large radome.

Boeing Offers Multi-Mission C-135

By Russell Hinkle

Reason, Wink—Proposed Boeing C-135 airborne radar station aircraft is being offered to USAF for a variety of jobs. These include:

- Airborne early warning and control
- Airborne radar target station
- Photo-mapping and surveying
- Electronic warfare support systems

The C-135 is not to be confused with the proposed winged cargo carrier which is equivalent in size, weight and performance with the Boeing 707-430 intermediate-range airplane. The C-135 is not being offered with a winged tail and is approximately equivalent to the 707-120.

Like the 707-120, it will be powered by four Pratt & Whitney JT engines in great configuration. The airborne radar warning and control version probably will have F41 turbofan engines of the JT7.

The base C-135 can be delivered in quarter 17 months after authorization. Tested versions could probably be available as late as six months. The standard rate of a standard C-135 and KC-135 line can be reduced to 10 per

month from the present six per month of delivery.

The basic transport version is being designed for a maximum payload of 31,000 lb and a main cabin volume of 5,765 cu ft. The main deck cargo door at the forward end of the cabin measures 9 ft 9 in x 6 ft 6 in.

Basic C-135 Specifications

Weight	
Maximum lift-off gross weight	797,000 lb
Maximum landing weight	151,000 lb
Operating weight empty	97,900 lb
Maximum fuel weight	
	281,500 lb (11,330 gal)

Performance	
Engine	TAW JT
Sea level thrust-out	21,750 lb
Sea level thrust-idle	11,200 lb
Capacity	
Maximum payload	31,000 lb
Main cabin volume	5,765 cu ft
Main cabin length	51 ft 4 in
Main cabin height	7 ft
Main cabin width	30 ft 9 in
Cargo door	6 ft 6 in x 6 ft 6 in

If the airplane is to be used as a platform for large electronic systems, the big cargo door would make it possible to load and unload large modules and equipment racks without disassembling them.

The equipment would be located in the pressurized cabin area and most of the structural cutouts for antennas and other external equipment could be made in the skin of the unpressurized lower fuselage section to maintain weight and cost.

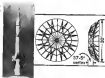
Multiple Load Path

The multiple load path structure of common jet transports simplifies the job of diagnosing structural problems because it is easier to avoid seriously weakening the fuselage. Openings up to 15 in in diameter can be made in the skin with out cutting a circular frame. Large-radius stiffeners are continuous between frames and skins, so splices can be made at any point. If additional equipment space is needed, some of the tail bulkhead or the lower unpressurized section could be sacrificed to make room for it.

Boeing reports the usage of the



This precision 30-foot antenna has a more accurate surface than any other production parabolic reflector of comparable size.



Antenna Systems' new solid surface, high precision 30-foot antenna (model 300) is designed to set a new standard for accuracy in the fields of radio astronomy, space-vehicle weather propagation, tracking radar, and experimental test installations, etc. features:

- High precision — The static surface tolerance of the first unit has been measured. The deviation from the ideal curve measured 0.032 inches RMS.
- Free in 1/4 inch of DAST which readily adapts to a wide variety of feed systems.
- Fully mechanical sections are interchangeable and easy to assemble.
- Solid surface panels permit use at any frequency.
- Detachable with a wide variety of feed support systems.
- Built to withstand 150 MPH wind with 47 lbs.
- Can be mounted on either the top or side of a tower with azimuth and elevation adjustments, or also in equatorial pedestal, self-contained trailer tower mounts, or other types of mounts.

Write for specification sheet.

ANTENNA SYSTEMS INC. HINGHAM, MASSACHUSETTS

C-135 Special Versions

Airborne Early Warning & Control
 Added system weight 25,000 lb
 Maximum range 4,700 naut. mi.
 Maximum altitude 47,000 ft.
 Maximum refueling time 10 hr.
 (JTF FSW engine)
Airborne Missile Range Station
 Added system weight 15,000 lb
 Maximum range 4,700 naut. mi.
 Maximum altitude 50,000 ft.
 Maximum refueling time 10 hr.
 (JTF FSW engine)
Electronic Warfare Office Trainer
 Added system weight 10,000 lb
 Maximum range 4,700 naut. mi.
 Maximum altitude 50,000 ft.
 (JTF FSW engine)
As Photo-Mapping and Surveying
 Added system weight 5,000 lb
 Maximum range 7,700 naut. mi.
 Maximum altitude 50,000 ft.
 (JTF FSW engine)

C-135 is more than 7,700 naut. mi. with a 10,000 lb. payload, or over 5,000 naut. mi. with the 25,000 lb. maximum payload. The wide variation is made possible by the small ratio of operating weight-to-payload to maximum takeoff gross weight.

For such missions as early warning or missile range telemetry missions, the C-135 can keep station due to its base for up to 39.5 hr. at optimum altitude or 14.6 hr. at sea level. Basing rates the high speed and long range of the C-135 would result in a high rate of two-on-strike to total mission duration.

Seize Pitch

An important point in the Boeing order pitch for the C-135 is the package along the learning curve made with the newly identical KC-135 tanker and the family of Model 707 commercial jets. The company claims that Air Force contracts show the KC-135 has a 91.9% probability of completing a normal 6 hr. mission without delays or deviations due to mechanical trouble. At the beginning of 1975, the probability was set at 79%.

Boeing proposes an average C-135 utilization of 5 hr. per day at eight-hour maximum stay down and zero 16 hr. per day utilization should be attainable for 15 hr. missions. These statistics are largely based on commercial 707 utilization of 5.41 hr. a day with flights lasting from 5-6.5 hr.

Maintenance will be about the same as that for the KC-135. Its postflight inspection interval has been increased from 25 hr. to 300 hr. in 1975. Boeing says pilots are under way to ease the periodic inspection interval to 600 hr. The jet transport should offer a good

environment for the sensitive avionics used in the proposed missions. Spurious, due to vibration, noise, extreme barometric and pressure variations are much lower than in jet-propelled aircraft being used for comparable jobs. The C-135's airframe/avionics system can sustain an air level altitude up to an engine altitude of 22,000 ft. and a 7,000 lb. cabin altitude at an engine altitude of 40,000 ft.

Design Payload

The main cabin floor of the C-135 is designed for distributed loads up to 700 psf. Equipment bins and consoles would be located in the right part of 10,000 lb. tie-down fittings arranged along the sides of the deck at the 5,000

lb. fittings distributed over the floor on a 20 in. grid pattern. As an airborne missile range station, the C-135 would be given an extended nose radome and a long dorsal blister in which to locate television cameras, tracking cameras, etc. The use of an external blister would seem to offer a wide angle of coverage and minimize the number of holes to be cut in the pressure cabin.

The crew's warning system drawings show an unusual electronic scanned three-beam antenna which gives 180 deg. coverage. One sector is covered by a long-forward-angle, yoke-shaped antenna extending upward from the top of the fuselage to provide coverage below the horizon.



Alouette III Undergoes High Altitude Tests

Alouette III, powered by an Alouette III engine rated at 700 hp, is shown undergoing tests in the French Alps. Two prototypes of the Alouette III which first flew in February, 1975 have been selected for military evaluation.



BASIC BUILDING BLOCKS FROM KEARFOTT



EXPLOSION-PROOF AXIALVANE BLOWER MOTOR

This thermally protected, explosion-proof induction motor drives an AxialVane Blower unit used as an expander on aircraft air conditioning systems. With frequency high output, it weighs little in an extremely compact package and performs with the requirements of MIL-E-16700A. Motor has been extensively tested to conform with MIL-E-16700A, per Procedure I, covering loadability, high and low temperature, explosion-proof, altitude and vibration requirements. These Model 7-35-2 motors are produced by Kearfott's subsidiary, the Martin Electric Company.

SPECIFICATIONS

Model 7-35-2

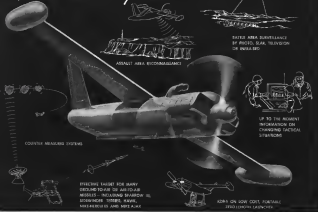
R.P.	15.4
HP	20
Phase	3
Output	400
Wt.	11 lbs.
Size	6" diameter
Dimensions	14" x 14" x 14"
Weight	12.5 lbs.

Write for complete data.

KEARFOTT DIVISION
GENERAL PRECISION, INC.

Little Falls, New Jersey

BEECH "IMAGINUTY" IN Missile Target and Reconnaissance Systems



Beech Army/Navy KDB-1: Versatility at low cost . . .

Radio-controlled operational missile target of proven reliability for a wide range of needs

Designed to meet advanced weapon systems training and evaluation requirements, the Beech KDB-1 has demonstrated its suitability in a wide variety of missions. With a top speed of 243 mph and flight endurance of more than one hour, the KDB-1 has the versatility required to fulfill a wide range of missions in addition to those shown above. It can fly at altitudes

in excess of 48,000 feet and can carry payloads of up to 220 pounds and up to 4 cubic feet.

Already operational and simple to use, the KDB-1 can be supplied rapidly to field commanders and can be operated by relatively unskilled people. All equipment and tools required for ground support are fully developed, available and ready for use.

Beech Aerospace Division

BEECH AIRCRAFT CORPORATION • WICHITA 1, KANSAS

equipment including cathode ray tube oscilloscopes, industrial cathode ray tubes and associated electronic devices, and other electronic equipment used in conjunction with aircraft for pit and pattern engine control. The company is also engaged in defense production and defense research and development contracts dealing with electronic communications equipment, patch interposition networks and other electronic items. Offering is 300,000 shares of common stock, for public sale at \$1 per share. Proceeds will be used primarily to accelerate the development of the company's computer items for the purpose of expanding its commercial business. It is estimated that \$180,000 will be allocated to research and development costs for new proprietary items of electronic equipment, \$150,000 to acquire components for the manufacture of new electronic equipment pursuant to defense contracts, part will be used to increase sales personnel, and the balance for general corporate purposes.

Bechtel Dynamics, Inc., Brooklyn, N. Y., engaged in designing, engineering, manufacturing, producing and selling electrical and mechanical assemblies, electronic and missile launchers, components and special tools and instrumentation. Offering is 124,000 shares of common stock, for public sale at \$6 per share. 68,000 shares to be offered for the account of the company, and 56,000 outstanding shares in the present holders.

Electro-Tec Corp., South Hackensack, N. J., engaged in the design, development, manufacturing and sale of wiring and break block assemblies, switching devices and relays for electronic equipment. Offering is 113,000 shares of common stock for public sale, offering price and underwriting terms to be supplied by underwriter. Of the offering, 75,000 shares are to be offered for the account of the company, and 38,000 outstanding shares in the present holders thereof. Proceeds will be added to the company's general funds and used for general corporate purposes. Also approximately \$70,000 will be used for construction of a new plant in New Jersey to replace leased facilities in South Hackensack, and approximately \$50,000 will be used for additional tooling of new production facilities.

Honey Aluminex (Berk) Transcon, Corp., producer of primary aluminum and fabricating aluminum products, aluminum products for use in nuclear reactors and titanium products for sale primarily to the aircraft and missile industries. Offering is 750,000 shares of A common stock, for public sale at

**BASIC
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BLOCKS
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SIZE IT MOTOR GENERATOR

Featuring 300:1 Signal-
to-Noise Ratio

The high performance Size 11 Servo Motor Generator features 11 phase output and a signal-to-noise ratio of 300:1. It is designed primarily to replace Size 10 units in high gain decoupling applications. In-phase speed-sensitive output variations due to temperature variations are stabilized to within 0.25% over the temperature range and speed-sensitive voltage and frequency variations are stabilized to within ±0.2% for voltage and 0.68%/rpm for frequency.

ELECTRICAL CHARACTERISTICS

NOTE	Full	Full	Full
	Load	Load	Load
Voltage Input	110	20	18
Frequency Input	400	400	400
Excitation	50	100	100
Power Input	2.0	2.0	2.0

CONNECTIONS

Excitation	110 VDC, 400 cps
Full Load at	
Full Load	0.99
Power Input at	
Full Load	0.7
Regulation	0.04%
Linearity	0.02%

MECHANICAL CHARACTERISTICS

Rated Input	500 W
Full Load	4.50 in. in
Rated Output	
Full Load	2.2 gpm
Acceleration	2500 rpm/min
Weight	10 lb

Write for complete data.

**NEARFOT DIVISION
GENERAL PRECISION, INC.**

Little Falls, New Jersey



Beech Ships Four Planes to Germany

Beechcraft Dynamics Model 31 four-seater loaded into a Luftwaffe Lockheed Super Gm defensible 1649 freighter at Wiesbaden, Germany. Four planes are M15 Mustangs and three Dynamics, were shipped on this flight. A four-seater had held the four sets of wings. Cargo included several tons of spare parts.

U.S.A.C. TRANSPORT TRUCKS HAVE CARRIED

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REGULUS II
OROMES
QUAIL
PETREL
SPACE CAPSULES
SOLID PROPELLANT
RADIAL CYLINDER
JET THRUST and
ATOMIC ENGINES
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OUR FLEET TRAVELS
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WRITE US NOW

457 WEST FORT ST.
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Bristol Type 188 Research Aircraft Nacelle

Engine nacelle for the Bristol Type 188 supersonic research aircraft will house the de Havilland Gyron Junior turbojet engine and afterburner. Streamlined nacelle which will house the aircraft's two propellers are 3 ft 9 in. in diameter at their widest point.

\$22.75 per share. Proceeds will be added to the general funds of the company for application to the expansion program now in progress and scheduled to be completed by the end of 1960, to the extent not so applied, to working capital and as such will be used for the payment of indebtedness and other corporate purposes.

Acquisitions And Mergers

Lithon Industries, Inc., has purchased a majority interest in First Ridge & Co., GmbH, West German manufacturer of advanced electronic equipment, for an undisclosed amount of cash. The company is located at First Ridge-Strasse 10, Bad Vilbel, Germany, is housed in a modern, five-story building of 65,000 sq. ft., and has 423 employees.

Houston Fluidics Corp. has acquired Merchett Associates, a Boston electronic manufacturing engineering company formerly affiliated with Avco Corp.'s Gasco Division. Terms of the acquisition were not announced. Houston Fluidics' federal group headquarters in Boston, will be responsible for industrial

division direction of the Merchett operations.

Financial Briefs

Acropet-General Corp. earnings for the six months ended May 31, were \$4,450,518 on consolidated sales of \$200,611,325. This compares with the previous year's first-half earnings of \$3,632,661 on sales of \$154,636,167.

Ryan Electronics Division of Ryan Aeronautical Co., San Diego, has been awarded a \$17,150,000 letter of intent by Navy Bureau of Weapons for additional Ryan APN-122 supply and navigation. Deliveries are scheduled to start in February of 1961.

Milko Maryland Industries, Inc., is now being approved by stockholders of Milko Maryland Misses Corp. The company has added the following divisions: Force Cast, producers of precision castings for aircraft and missile applications; Magnetics, producers of precision magnetic systems and magnetic heads; and Universal Research & Testing Laboratories, an environmental testing facility. Space Systems & Industrial Automation, a new subsidiary is engaged in research, analysis and development.



KEARFOTT produces

precision floated gyros

for the **Polaris** missile.

Engineers Kearfott offers challenging opportunities in advanced component and system development.

KEARFOTT DIVISION
Little Falls, New Jersey



GENERAL PRECISION, INC.
Other Divisions: GPC, Lubbock, Lubbock

CLASSIFIED

EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY

ADVANCED PROJECTS AT LOCKHEED

THE KING KIM Now in its advanced development status, the Navy-Lockheed POLARIS Fleet Ballistic Missile is scheduled to be fully operational and aboard its specially designed submarines late this year. Full-scale test vehicles have been successfully flown on a regular schedule of flights for months with only one failure, a remarkable achievement in view of the numerous operational problems involved in its underwater launch. With nearly three-quarters of the earth's surface being water, practically no target in the world is outside the POLARIS' range of over 1200 nautical miles. The Division is systems manager for the POLARIS under the direction of the Special Projects Office of the Navy

THE AGENA Fully reusable. The Air Force-Lockheed AGENA satellite is a versatile space vehicle capable of numerous assignments. In its present DISCOVERER program configuration, it is 15 feet long, 3 feet in diameter with an orbital weight of approximately 1700 pounds. Payload of several hundred pounds includes telemetry, instrumentation, guidance and attitude control systems, reentry vehicle and recovery capsule. The AGENA has accomplished several significant space "firsts." It was first to be placed on the difficult polar orbit, first to be placed on a precise, preplanned, and accurate circular orbit, first to change its attitude on orbit, with a turn of 180 degrees and a downward tilt of 50 degrees, first to eject a capsule, and first to prove advanced space systems such as ground-space communications, instrumentation, attitude and guidance and life-sustaining devices. The AGENA can be modified for a variety of space missions such as navigation, geophysical investigations, laser probes, long-range communications, and space probes.

In addition to the DISCOVERER program, the Division is developing advanced AGENA variants for the MIDAS program (Missile Defense Alarm System) and the SAMOS strategic warning system. Lockheed is systems manager and prime contractor for these projects under the direction of the Air Force Ballistic Missile Division (AFBMD).

THE ASTRANG An orbiting research facility to serve as an advanced base for space exploration, has been proposed to practical detail by Lockheed's research and development staff. The station would carry a 10-man crew. Prefabricated components for the rim of the wheel, the spokes, and the three hubs would be launched separately by ballistic missiles and assembled in space by means of the specially-designed, Lockheed Astrang.

THE X-7 The Air Force-Lockheed X-7 solid-propellant ballistic missile has pioneered many new techniques, and the valuable experience gained from this program focused development of other, more advanced projects, including the Navy POLARIS FBM. The Navy's Project Argus reduction explosion testbed X-17 as the vehicle. Developed for the Air Force, the Lockheed KINGFISHER is designed to simulate enemy attacks to test our nation's anti-bomber and anti-guided-missile defenses. The Air Force X-7 is a unique, recoverable ramjet-engine test vehicle designed to test new developments in advanced components for other missiles. The successful completion of projects such as these requires a bold and imaginative approach to entirely new environments. Lockheed's programs reach far into the future. It is a rewarding future which scientists and engineers of outstanding talent and ingenuity must see in their vision. While Research and Development Staff, Dept. G-17A, 562 W. El Camino Real, Sunnyvale, California, U. S. citizenship or existing Department of Defense industrial security clearance required.

Lockheed

MISSILES AND SPACE DIVISION

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AEROWASH-A

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Those sleek, gleaming, gleam-ton jets pose some pretty tough cleaning problems. Aerowash-A is equal to the toughest of them . . . actually removes jet-engine exhaust stains with very little hand labor!

This is itself a quite remarkable . . . but even more so is the fact that, despite its cleaning effectiveness on all common metals, AEROWASH-A will not damage interior surfaces. It is safe to use on plastics, fabrics, or rubber. It is non-toxic, mild on skin, and nonflammable when diluted with water or used straight. And it is Air Force approved!

For full details on Aerowash-A, and other aircraft-cleaning products, call your Wyandotte representative. Or mail the coupon below. Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also Los Angeles, California, and Atlanta, Georgia. Offices in principal cities.



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Specialists in Aircraft-Cleaning Products

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| <input type="checkbox"/> Carbon Removal | <input type="checkbox"/> Aircraft Fueling |
| <input type="checkbox"/> Metal Cleaners | <input type="checkbox"/> Chemical Stripping Aluminum and Anodizing |

Name _____ Title _____

Firm _____

Address _____

City _____ State _____

Stock Transactions

The Securities and Exchange Commission reported the following additional transactions during the period from May 11 to May 16, 1950:

James Henderson, Inc. (Delaware) (public) transferred 400 common shares to Patrick E. Henderson, officer and director, having a holding of 120,000; disposition of 100 common shares by J. E. Henderson, officer, having a holding of 20,000 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (Delaware) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (Delaware) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000.

Medco Chemical Corp. (Delaware) of 100 common shares to J. E. Henderson, officer and director, having a holding of 120,000; Henderson, (Delaware) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (Delaware) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000.

Thompson Radio Manufacturing Co. (Delaware) of 100 common shares to J. E. Henderson, officer and director, having a holding of 120,000; Henderson, (Delaware) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (Delaware) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000.

Western Air Lines, Inc. (California) of 100 common shares to J. E. Henderson, officer and director, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000.

Transactions reported during the period from Feb. 11 to May 10, 1950, included:

Alphacore Airline, Inc. (California) of 100 common shares to J. E. Henderson, officer and director, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000.

Aviation Corp. (California) of 100 common shares to J. E. Henderson, officer and director, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000.

Chemical Products for Aircraft Detail Services (California) of 100 common shares to J. E. Henderson, officer and director, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000.

Chemical Stripping Aluminum and Anodizing (California) of 100 common shares to J. E. Henderson, officer and director, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000.

Jet Engine Cleaning (California) of 100 common shares to J. E. Henderson, officer and director, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000.

Jet Fueling (California) of 100 common shares to J. E. Henderson, officer and director, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000.

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Dassault 410 Spirale Equipped for Combat

Dassault 410 Spirale, military version of the Dassault Constante Forme aircraft, is shown (left) equipped with four 30-mm M41 rocket launchers and (below) taking off with a pair of 400 Bb bombs. Spirale is powered by two Turbomeca Turbomec engines rated at 1,000 each. May 1950. Spirale was designed specifically for use in Algeria, but no military orders have been received to date.



Aviation Corp. (California) of 100 common shares to J. E. Henderson, officer and director, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000; Henderson, (California) (private) of 100 common shares to J. E. Henderson, officer, having a holding of 120,000.

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refillable overpressure—
act as quick opening valve



Fike manufactured rupture units are ideal where space weight or special installation problems are encountered. The rupture unit will relieve overpressure or act as a quick opening valve by rupturing pressure inside metal rupture disk at a predetermined pressure.

Units as small as 1/2" to 36" in diameter with 1/2" to 36" rupture disks are illustrated above. Depending on the application, rupture pressures of 200 to 6000 PSI are possible in similar units.

Special assemblies can be provided for a specific requirement. We welcome inquiries on special and unusual applications.



METAL PRODUCTS CORP.
Blue Springs, Missouri



NASA Launches First Complete Prototype Scout Research Rocket

First firing of three controlled solid propellant stages of Scout rocket vehicle took place at Wallops Station, Va., on July 1, as part of a NASA program to develop a small, reliable and flexible solid-fuel research vehicle designed for a variety of upper exploration missions. The TWR Scout carried a 950-lb payload. Launch of the fourth stage was prevented by command when the vehicle appeared to vent off coarse NARA ethanol and Hot Scout reached an altitude of at least 660 mi. and a stage of approximately 1,300 mi. Excellent telemetry was obtained through the flight of the first three stages of the 36,100-lb vehicle.



CAB Accident Investigation Report:

CAB Revises Earlier TWA Crash Report

From World Airlines Flight 246, a Mac 747-200, N4000, crashed Sunday morning near Minneapolis. N4000, 19 10 1952, about 0711Z. All 15 occupants were killed and the aircraft was destroyed (AV No. 75, 1955 p. 58).

An investigation was conducted by the Civil Aeronautics Board immediately after the accident. This included examination of the wreckage at the crash site, a detailed dissection because of fuel leaks and dangerous burning at the maintenance facility. On May 7, 1975, a second trip was made to the scene of the accident and the results of the wreckage were examined. On Oct. 12, 1975, the Board's findings were reported in a report.

On Oct. 12, 1975, the Board's findings were reported in a report. The probable cause was determined to have been lack of conformity with prescribed on route procedures and a diversion from towers at an altitude too low to clear obstructions.

Because of satisfactory crew actions at the time of the report of Oct. 12, 1975, solid fuel stage was removed from the facts and circumstances of the accident and an amended report was issued to the Board on Aug. 28, 1975.

The probable cause of the accident in this report is amended to that of the first report although the risk as parties are allowed to review the report that the direct cause was taken.

On Oct. 12, 1975, the Air Line Pilot was presented to the Board of Safety. The Board's findings were reported in a report. The probable cause was determined to have been lack of conformity with prescribed on route procedures and a diversion from towers at an altitude too low to clear obstructions.

On Nov. 24, 1975, a flight trip to the accident site was made. The Board's findings were reported in a report. The probable cause was determined to have been lack of conformity with prescribed on route procedures and a diversion from towers at an altitude too low to clear obstructions.

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and pertinent evidence by any interested party.

The Board in this supplemental analysis has taken of considerable testimony and information supplied by interested parties. The ALPA presented a detailed review of the Board's report and submitted several theories to account for the flight path deviation. In the light of additional information and a study of the Board's findings, the Board's report in the report need to be revised and are corrected in the document which follows.

1. Captain's Experience. The Board's study of the report of Aug. 28, 1975, Captain Graham's experience over the Minneapolis-Kansas City route only for the course of the accident and for the previous month. It did not mention his flying this route during previous years. He had flown the Minneapolis-Kansas City route a total of 32 trips and the Minneapolis-St. Paul route a total of 24 trips. Thereby he was the most experienced pilot on the flight path as was Captain Smith.

2. Captain's Experience. During the first part of the crash, on Nov. 24, 1975, the heading at the time of crash was determined to be 195 deg magnetic. This deviation was determined in a sub-compass which was magnetic from at four local stations. Previously the heading was believed to be 220 deg as determined by a magnetic compass.

From the evidence that the accident report has been taken to the fact that about 15 deg. heading the direction was believed to be 220 deg as determined by a magnetic compass. From the evidence that the accident report has been taken to the fact that about 15 deg. heading the direction was believed to be 220 deg as determined by a magnetic compass.

3. Weather. A detailed review of the official weather observation at Minneapolis Field, Minneapolis, and the observations of ground vehicles indicate that weather conditions directly over the field and throughout the western winds were clear. The Board's findings were reported in a report. The probable cause was determined to have been lack of conformity with prescribed on route procedures and a diversion from towers at an altitude too low to clear obstructions.

4. Terrain. A detailed review of the terrain data of the flight. The Board's findings were reported in a report. The probable cause was determined to have been lack of conformity with prescribed on route procedures and a diversion from towers at an altitude too low to clear obstructions.

5. Terrain. A detailed review of the terrain data of the flight. The Board's findings were reported in a report. The probable cause was determined to have been lack of conformity with prescribed on route procedures and a diversion from towers at an altitude too low to clear obstructions.

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12. Terrain. A detailed review of the terrain data of the flight. The Board's findings were reported in a report. The probable cause was determined to have been lack of conformity with prescribed on route procedures and a diversion from towers at an altitude too low to clear obstructions.

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in reference to the RAMP or NDB. Consider the fact possibility that of using our leading radio station from the aircraft's cockpit, we find a more flexible explanation for the assumption of an aircraft leading in with the failure to detect the over quickly. Perhaps, as well as detected, remote radio station but one of the two system options need be assumed.

The investigation concerned in all the time produced to the result of a third stage transmitter. Paper leading in formation is dependent upon the wing element being held at all times in a horizontal plane. Stability of the element is obtained through the use of a third gyro within the flight transmitter. The gyro of the wing-carrying type and a solid-state quartz crystal oscillator is provided as the basis of a quartz oscillator directly operated and controlled by a quartz crystal. The quartz oscillator employed prior to itself with the gyro to the quartz crystal position, having in fact position to the solid-state oscillator.

Although manufacturing of a flight transmitter can produce a great deal of time, the operating conditions of the transmitter are the subject of our research. Remote radio station with only parts of our, possibly more involved.

It has been demonstrated that it is possible that when first assigned the gyro can assume a tilt angle that will produce constant leading information when the aircraft is on the ground. However, we will assume otherwise, as the aircraft assumes other headings. Thus, before we can the gyro be secure of its design, we must have direct line results in making design of its direct leading line dependent upon spatial leading heading, relative strength of horizontal and vertical components of the aircraft's local magnetic field, and upon the degree and direction of gyro tilt. Perhaps this, in fact, is not a simple or impossible and the former statement is that the gyro responds to its reference mechanism. Therefore, at the aircraft, low tilt results with the gyro, involving approximately two degrees per second if it is possible that an aircraft could become airborne before its gyro tilt is reached.

Also to be considered is the possibility of gyro tilt as the result of a rising angle along plane while the aircraft is banked. That such an action occurred during the period that the aircraft was in the air has also already occurred in the case of some aircraft or where an aircraft's compass heading information would be displayed and the gyro had again been secured in its self-correcting function. Further, the error produced under these conditions is one that would accurately be the result of being flown on a magnetic heading in order for the compass system to indicate a suitable heading.

Heading information from the flight compass system is supplied in fact directly to the RAMP or NDB on each pilot's instrument panel. The NDB's compass heading information from separate flight compasses located in the left wing tip of the RAMP is a direct statement which is received by leading information from an NDB to the subject aircraft both RAMP's and

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Dr. N. J. Korman, Director
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WHO'S WHERE

(Continued from page 23)

Changes

Dr. Peter Forrester, chief research and development engineer of the newly organized General Motors Research, Zurich, Switzerland. Dr. Forrester, chief research and development engineer of General Motors Division of General Motors Corp., New York, Calif.

Capt. George D. Chouinard, system chief pilot, Naval Information Systems. Also Capt. M. G. Kohn, system chief pilot, Capt. James W. Brown, system chief pilot.

Prof. Thomas Gold, a special consultant to National Research Corp., Cambridge, Mass. Prof. Gold is director of General University's department of astronomy and director of the astrophysics and space research center.

H. C. Gorman, microelectronics engineer, IBM Research Corp., New York, Calif.

Joseph Robert Lewis, director of operations, Johns Hopkins University, Baltimore, Md. Also, Lewis is director of the Johns Hopkins University, Baltimore, Md.

Frank J. Murphy, manager of operations, General Dynamics Corp., Pomona, Calif. British Aircraft Corp., Ltd., has announced the following appointments:

Robert E. Knight, technical manager, Los Angeles, Calif. Also, Knight is technical manager of the newly established Special Military Vehicle Operations, Defense Products Group of Ford Motor Co., Dearborn, Mich.

Robert F. Thornton, general manager, Defense Products Group of Ford Motor Co., Dearborn, Mich.

Dr. Solomon I. Miller, head of the research section, Research and Development Department, Johns Hopkins University, Baltimore, Md.

William R. Feltz, Jr., senior design engineer, IBM Research Corp., New York, Calif.

Dr. Robert M. Feltz, director of research, Military Systems Division of Lockheed Electronics Co., Palo Alto, Calif.

Vernon H. Hines, manager, New Products Office of John Deere, Moline, Ill.

Joseph A. Smith, sales manager, Aircraft and Missile Support Department, the Hall-Edwards Co., Chicago, Ill.

Leonard F. Gellish, chief engineer, Air Force, Greenville, Calif.

Arthur H. Williams, director of research and development, Shale Research Division of Chem. Ind. Co., Danvers, Mass. Also, Williams is director of research, Shale Research Division of Chem. Ind. Co., Danvers, Mass.

R. E. Williams, director of military

sales, Librascope Division of General Electric, Inc., Glendale, Calif.

Thomas A. Gorman, Jr., manager of Cryogenics, Division of Standard Oil Co., Los Angeles, Calif.

M. Edward Gough, chief metallurgical engineer, Canadian Ltd., Montreal, Canada. Also, Gough is chief metallurgical engineer of Canadian Ltd., Montreal, Canada.

Robert F. Squires, manager of sales, American Cyanamid Co., New York, N.Y. Also, Squires is manager of sales, American Cyanamid Co., New York, N.Y.

Robert S. Landman, chief engineer, Pacific Northwest Products Co., Los Angeles, Calif.

John D. Moss, general sales manager, Kierulff Aircraft Products Co., Denver, Colo., a subsidiary of New Britain Wire Works Co., New Britain, Conn.

George Lutz, chief engineer, Pacific Air Lines.

John H. Hadden, management director, Lockheed-California Division, Burbank, Calif.

George Stenning, manager, Western region, Lockheed Division of General Motors, Los Angeles, Calif.

Donald J. Fong, director of new product development, Westinghouse Electric Corp., Pittsburgh, Pa.

Robert K. Lewis and **George D. Fugley**, electronic service representatives, Raytheon Electronics, Division of Raytheon Company, Lexington, Mass.

Dr. Chao H. Li, head of the Materials and Techniques Research Group, General Electric Corp., New York, N.Y.

Frank J. Murphy, manager of operations, General Dynamics Corp., Pomona, Calif.

Robert E. Knight, technical manager, Los Angeles, Calif. Also, Knight is technical manager of the newly established Special Military Vehicle Operations, Defense Products Group of Ford Motor Co., Dearborn, Mich.

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Leonard F. Gellish, chief engineer, Air Force, Greenville, Calif.

Arthur H. Williams, director of research and development, Shale Research Division of Chem. Ind. Co., Danvers, Mass. Also, Williams is director of research, Shale Research Division of Chem. Ind. Co., Danvers, Mass.



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AVIATION WEEK, July 18, 1968

LETTERS

'Checklist Reader'

Re Letter "SAC Meets" issue of July 4 (p. 101). I SAC "conclude" 0-0 copy! McDonald of MacDill AFB "mail" copy! I wish him a speedy exit from the Air Force. "Today's professional" aviators have no place for any person unable to accept responsibility and the entire Air Force especially SAC, can do better without this office of "Invisible Chicken" and lead spawners.

Does he think he is the only fighter pilot who was ever assigned to multi-engine aircraft?

My Center-area briefing did not break me to back out of an undesirable position, as it evidently did this officer, who "lack himself" occurred in the past of an operation. "me" Fly he cannot believe that this "aggressor" is not his he includes me. Fly even more that he cannot refuse the opportunity available to him to enhance his flying ability and efficiency by being a member of the United States Air Force, not only SAC Me, but you are no better than for out of his checklist, and probably much of who must associate with him outside as he wishes it were a ghost.

I want this man gone, not a check carded by Air Force rules, but a fellow officer willing to me, such is the same way in this letter, make me realize that today, fighter pilots are cheap but good officers are not.

Have you forgotten that you are an officer first, a pilot second?

Now at a confidentially source: commander (KASAC). I want you to check the "check fighter pilot" turned "checklist" made me be assigned to my crew, he will know me as a checklist reader, but he apparently cannot be given the responsibility to do anything else.

Mr. L. E. Grier & Son, Inc., 4010, Air Boulevard, Springfield, Mass., is a fine place to go.

'In Praise of Quesada'

When Ferdinand Quesada was facing Gen. E. B. "Pete" Quesada the lack of courage the old short light duty pilot said, he was not out of his head.

Yes, because Mr. Quesada offers to submit to the principle that fighter pilots can do so wrong, his job has been a little less than the best.

Personal and energetic ALFA President Claudio Sarno, who has led the Air Line Pilot's Association and a successful labor organization. He is now making well paid pilots and leaving them motivated. And he intends to keep things that way.

In the latest dispute between the pilots and the Federal Aviation Agency, new ideas superseded any of shared pay, resulting in a strike against Eastern Air Lines and its employees. "Whereas" in Air America, the pilots demonstrated how they really should do their own way.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 319 W. 42nd St., New York 36, N. Y. For to keep letters under 300 words and give a general identification. We will not print anonymous letters, but names of writers will be withheld on request.

If FAA inspectors can occupy the third pilot's seat, the same number's role is obviously compromised. Such a restriction may make it difficult or impossible for ALPA to get the third pilot assigned next time when the industry agrees.

In addition, there has been some problem of someone pilot quality in jet service aircraft.

Combined with a rising backlog of the compulsory recurrent apt. Such a change an opportunity to make trouble for Mr. Quesada's supporters.

But even supposing that any of these problems is the last that the last time in his career, pilots have been his best customer, he can make his own business.

In addition to overlooking the CAA, "detectors" have tackled the problem of service modernization and airport improvement.

He has achieved a better working relationship between military and civil aviation than any before.

Laugh through Quesada's insistence on apt training, pilot transition to new jets has been smoothly accomplished, and cockpit proficiency is being brought to a new high.

It seems strange that the same source pilots who were used for special government in the aviation industry, now having the same, such to check Quesada's ALFA under the crushing bureaucratic hand of the CAA.

Mr. Sarno represents our best with his alternative to Administration Quesada. And active pilots, acting like quality children by deliberately making a lack to work together, will only bring disaster upon themselves.

In view of the several examples of "ill-suited" senior leaders and the aviation industry, it would appear that compulsory retirement at 41 or 50 would be more in keeping with their physical condition.

New York, N. Y. Seattle, Wash.

Civil Defense

In the position as Executive Director of Miami Valley Civil Defense Authority, I have been a subscriber to AVIATION WEEK for some time, mainly because of the attention that it makes to AVIATION WEEK. In reference to jet defense display and capability (AW June 27, p. 21), the editorial by Mr. Robert Thorne correctly said that the military and civil aviation, without collecting one of the editorial and the advertisement published in AVIATION WEEK. I would like to bring to the attention of the editorial staff a public service that could be done for our nation that could be accomplished in no other manner.

Civil defense is a topic that is a step child by many people and officials, yet as you look through the advertisements in AVIATION WEEK all of them pertain to national industry which employs military workers. There is no advertisement in AVIATION WEEK on the part of the military service where they are building our great equipment, aircraft, missiles, computers and various electronic equipment, in some cases to the best reason for Civil Defense, which is to protect the civilian workers of industry who must manufacture the material and equipment used by the military service.

Our military service can no longer depend on the military link, and today our military link is in the protection of the civilian workers who provide the civilian service to provide control for the civilian service.

If this nation is to continue to be a leader, industry must accept some of the unique ability to provide control for the civilian service.

Only by such survival can industry continue to spend as providing the military service with equipment needed to provide military ability and a defense to our nation which would think of striking our country.

I would be very enlightening. I am sure not only to the officials of our nation but to the military, to find in AVIATION WEEK as editorial to reveal them that it is industry and civilian workers who provide the troops, ships and arms and armor of providing the military service with new needs.

STEVENS DILLON, Director, Miami Valley Civil Defense Authority, Dayton, Ohio.

Slick CL-44 Order

The management of Slick Aviation has for years been an interested reader of AVIATION WEEK and considered it as one of the best informed sources in the field of aviation in this country.

We read with particular interest the air transport article entitled "Cargo Aircraft Sales, Worldwide Activity" in your July 4 issue (p. 40). There is a self-written article which explains with clarity the present picture as it stands concerning either for the government or the private sector, there is a strong aviation interest in the move to the effect that Slick's line of the largest contract will allow as Cessna CL-44B turboprop as freighter only.

The fact is the line of this contract will be in your other order. Slick is definitely interested in the purchase of this aircraft and is preparing with plans to use them as its common cargo carrier.

Except as the result of national emergency, no plans ever to see them on common carriers.

KEVIN A. CHAPMAN, Assistant to the Executive Vice President, Slick Aviation, Inc., Washington, D. C.



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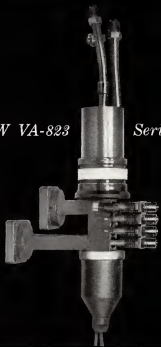
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